INTERNATIONAL ENERGY AGENCY

ENERGY POLICIES OF IEA COUNTRIES

2000 Review

OECD

INTERNATIONAL ENERGY AGENCY

Energy Policies of IEA Countries

2000 Review

INTERNATIONAL ENERGY AGENCY
9, rue de la Fédération,
75739 Paris, cedex 15, France

The International Energy Agency (IEA) is an autonomous body which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme.

It carries out a comprehensive programme of energy co-operation among twenty-four* of the OECD's twenty-nine Member countries. The basic aims of the IEA are:

- To maintain and improve systems for coping with oil supply disruptions;
- To promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations;
- To operate a permanent information system on the international oil market;
- To improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use;
- To assist in the integration of environmental and energy policies.

** IEA Member countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States. The European Commission also takes part in the work of the IEA.*

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- To achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- To contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- To contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996) and the Republic of Korea (12th December 1996). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

FOREWORD

Reviewing the energy policies of Member countries is a central activity of the International Energy Agency. Regular peer reviews have contributed significantly over the years to co-operation among IEA Members.

Each Member country is reviewed in depth every four years. The 1999/2000 review cycle included reviews of Canada, France, Luxembourg, the Netherlands, Portugal and Sweden. This book contains summaries of these six in-depth studies; the full texts are published separately. Shorter standard reviews were conducted for six Member countries: Austria, Denmark, Germany, Greece, the United Kingdom and the United States.

An Overview focuses on recent developments in the energy market and energy policy. The subjects highlighted this year include fuel prices in the past year, regulatory reform in the energy sector, policies and measures for global climate change mitigation, the research and development policies in Member countries and developments in major non-member countries. Key statistical information is also included.

Robert Priddle
Executive Director

ACKNOWLEDGEMENTS

Much of the information in this report is drawn from in-depth reviews conducted by representatives of IEA Member countries and members of the IEA Secretariat. The desk officer listed in each team was responsible for managing the review and was principal author of the report, which has also been published in a separate volume and appears in summary form here. The desk officers also wrote the shorter standard reviews included here.

Shigetaka Seki, head of the Country Studies Division, oversaw preparations for this book and wrote the Energy Market Trends section. Other sections were written by staff members from other IEA Divisions: Carlos Ocaña (electricity), Jochen Hierl (gas), Peter Fraser (coal), Jonathan Pershing (environment), Jean-Pierre Des Rosiers (efficiency), Maria Virdis (technology and R&D), and Jean-Christophe Fueg (non-member countries). Karen Treanton and Maria Mendiluce prepared the Key Statistics and Indicators, Monica Petit prepared the figures, and Marilyn Ferris provided administrative assistance.

1999-2000 In-Depth Reviews

Canada

Team leader: Hugh E. Brouwer (the Netherlands). *Team members:* Doug Cooke (Australia), Philippe Kahn (France), Russell Profozich (USA), Evelyn Bertel (NEA), Shigetaka Seki (IEA), Michael Landwehr (IEA), *Desk Officer:* John Cameron (IEA).

France

Team leader: Masaaki Mishiro (Japan). *Team members:* Graham Boyce (UK), Sigurd Lauge-Pedersen (Denmark), Alicia Mignone (Italy), Richard Greenwood (EC), Peter Wilmer (NEA), Shigetaka Seki (IEA), Jochen Hierl (IEA), *Desk Officer:* Gudrun Lammers (IEA).

Luxembourg

Team leader: Sue Harrison (United Kingdom), *Team members:* Helen Gratsia (Greece), Alicia Guimaraes-Purokoski (EC), Shigetaka Seki (IEA), *Desk Officer:* Pierre-Marie Cussaguet (IEA).

Netherlands

Team leader: Bertrand de l'Épinois (France), *Team members:* Uwe-Jens Lorenzen (Germany), Marit Måge (Norway), Pierre Mélon (Belgium), Richard Greenwood (EC), Olivier Appert (IEA), *Desk Officer:* Gudrun Lammers (IEA).

Portugal

Team leader: David Pumphrey (United States), *Team members:* Pascal Dupuis (France), Anja Silvennoinen (Finland), Jean-Francis Pasquier (EC), Shigetaka Seki (IEA), *Desk Officer:* Pierre-Marie Cussaguet (IEA).

Sweden

Team leader: José Sierra (Spain), *Team members:* Mirja Kosonen (Finland), Shin Morita (Japan), Knut Kübler (EC), Ivan Vera (NEA), Olivier Appert (IEA), Carlos Ocaña (IEA), *Desk Officer:* John Cameron (IEA).

Standard Reviews

Denmark, Greece, United Kingdom - John Cameron; Germany - Pierre-Marie Cussaguet; Austria, United States - Gudrun Lammers.

TABLE OF CONTENTS

PART 1 **List of Tables and Figures**

Tables

Figures

1

PART

OVERVIEW OF ENERGY POLICY AND MARKET DEVELOPMENTS

ENERGY MARKET TRENDS[1]

In 1999 and 2000 energy policymakers in IEA countries focused on reducing the effects of global climate change and made progress in regulatory reform. These efforts took place in an environment of sharply rising crude oil prices, which tripled between February 1999 and early 2000, affecting the prices of oil products and other fuels. Evidence indicates that regulatory reform improved the performance of energy markets in a number of IEA countries. More open energy markets improved economic efficiency and lowered costs. The growth in carbon dioxide emissions has been less than growth in gross domestic product in IEA countries over the last decade. Nevertheless, meeting the Kyoto targets remains a challenge.

Energy demand in OECD countries has grown over the past several years. Economic growth is the main determinant of energy demand: energy demand patterns reflect the varying growth rates among regions. In the OECD Pacific, economic stagnation in Japan led to decreases in energy consumption in 1998 from 1997. Recent recovery in Japan and very strong growth in Korea stimulated robust primary demand growth in 1999. World-wide, growth in natural gas demand was faster than growth for other fossil fuels, and particularly in the OECD Pacific, where gas is the favoured fuel for power generation. Strong growth in demand for transport sparked increases in final energy demand in OECD countries. Mild winters brought modest declines in residential and commercial energy consumption.

According to recent data for global energy supply, oil production declined in OECD North America in 1999, while production of natural gas increased significantly. Coal production declined in OECD Europe, following reductions in producer subsidies and restructuring of the coal industries.

Contrary to the effects of the second oil shock in 1979/80 on oil demand in OECD countries, the recent rise and increased volatility of oil prices has had less of an impact on final consumption. Various factors including taxes on fuels, level of tightness in the markets, difference in economic performance and exchange rates, have caused uneven impacts on fuel prices among IEA countries.

1. This book includes the most recent IEA data, available as of August 2000. For total primary energy supply, final data up to 1998 and estimates for 1999 (published in the 2000 edition of *Energy Balances of OECD Countries*) are provided in the text. For final consumption and energy production, data are available up to 1998 (published in the 2000 edition of *Energy Balances of OECD Countries*). Note that TPES includes all fuels including those used to generate electricity, while final energy consumption is the amount of energy consumed by end-users. For example, natural gas burned to generate electricity is covered by TPES but is not included in final energy consumption. Data for energy prices are available up to August 2000 (published in the *First Quarter 2000 edition of Energy Prices and Taxes*).

Energy intensity in OECD countries has fallen over the past three decades, as has carbon intensity, although charges in CO_2 emissions vary considerably across OECD countries. These differences are outlined in Table 4.

ENERGY DEMAND

Total primary energy supply (TPES) in OECD countries increased by 1.7 per cent in 1999 over its 1998 level, to 5,185 Mtoe. Demand grew by 3.5 per cent in the OECD Pacific region due primarily to strong economic growth in Korea. Energy demand also rose in OECD North America by 2.5 per cent in 1999 over its 1998 level, reflecting solid economic growth in the region. Energy demand was stable in OECD Europe.

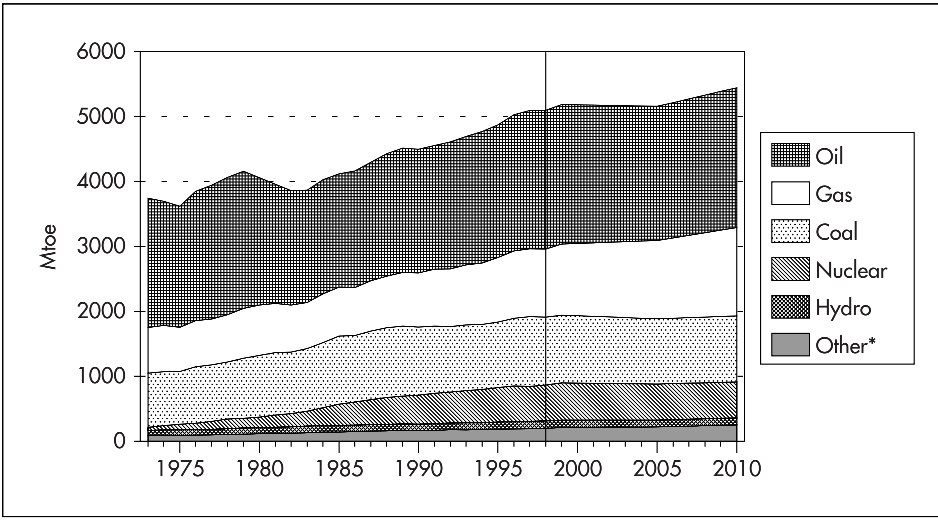
Primary oil consumption accounts for the largest share of total primary energy supply (TPES) in OECD countries, 42% in 1998. Natural gas, with a share more than half that of oil, is, however, the fastest growing primary fuel. Unlike oil demand which was largely stable and coal demand which fell slightly from 1998 to 1999, OECD gas demand grew by an estimated 4.6% in 1999.

Table 1
Total Primary Energy Supply in OECD Regions

	1998	*1999**	*Annual Percentage Change*
TPES Total			
Total OECD	5 097	5 184	1.7
North America	2 564	2 629	2.5
Europe	1 737	1 732	-0.3
Pacific	796	824	3.5
Oil			
Total OECD	2 137	2 148	0.5
North America	1 043	1 048	0.5
Europe	700	692	-1.1
Pacific	395	407	3.3
Gas			
Total OECD	1 048	1 096	4.6
North America	596	623	4.5
Europe	358	374	4.3
Pacific	94	100	6.2
Coal			
Total OECD	1 047	1 043	-0.3
North America	550	555	0.9
Europe	333	316	-5.1
Pacific	165	173	5.1

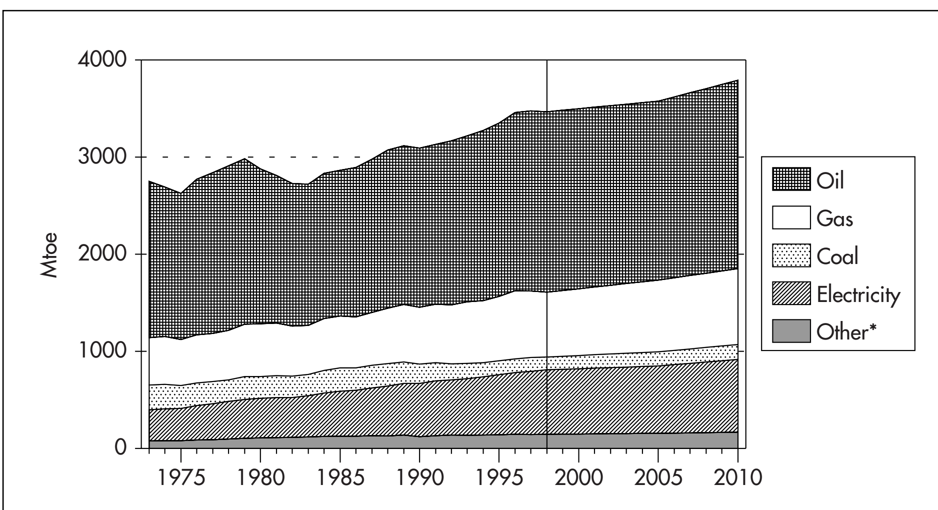
* Estimates based on preliminary data.

Figure 1
Total Primary Energy Supply in OECD Countries, 1973-2010



Note: Since forecasts for Korea, Mexico, Norway and Poland are unavailable, these countries are excluded from TPES from 2000 to 2010.
* includes combustible renewables, heat, geothermal, solar and wind.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and country submissions.

Figure 2
Total Final Consumption in OECD Countries, 1973-2010



Note: Since forecasts for Korea, Mexico, Norway and Poland are unavailable, these countries are excluded from TPES from 1999 to 2010.
* includes combustible renewables, heat, geothermal, solar and wind.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and country submissions.

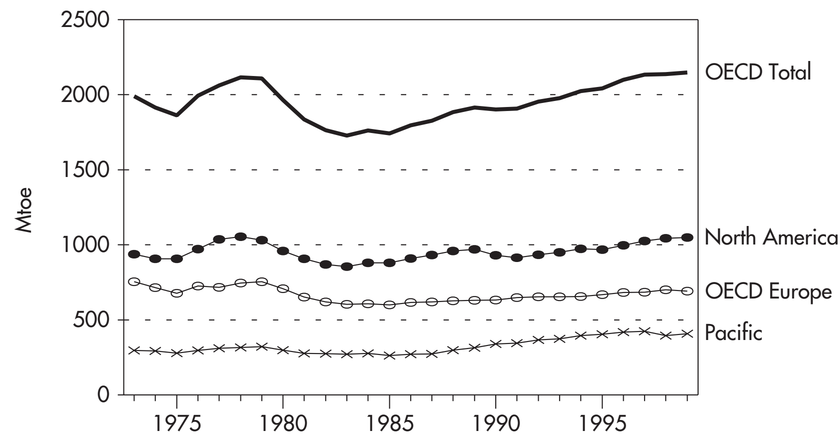
Energy Demand by Fuel

Oil

Oil demand in OECD countries increased slightly from 2,137 Mtoe in 1998 to 2,148 Mtoe in 1999. While oil demand in 1999 was higher in OECD North America and Pacific, oil demand in Europe fell by 1.1% in 1999 over its 1998 level.

Figure 3

Oil Demand in OECD Countries (by Region), 1973-1999



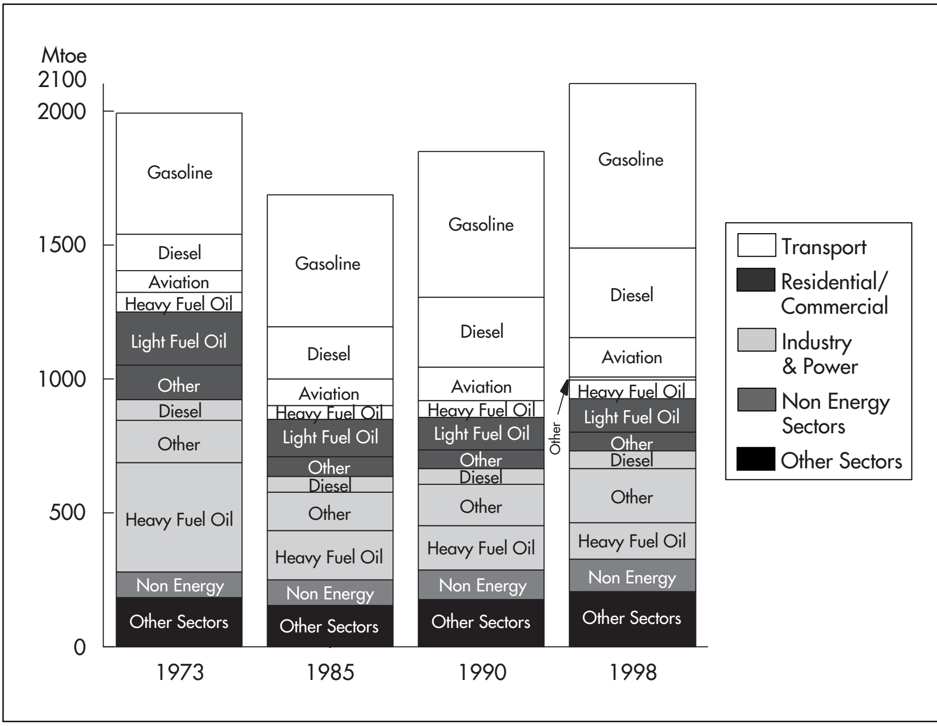
Note: 1 toe is slightly more than 12 barrels of oil.
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

Most of the recent increase in OECD Pacific oil demand can be attributed to the economic recovery in Korea, although oil demand in the region was still lower than its 1997 level of 423 Mtoe. Economic growth drove the higher oil demand in North America, while both cyclical and structural factors contributed to the decline in oil demand in OECD Europe. From 1998 to 1999, oil demand declined in Germany by 3.6 per cent, in Italy by 4.0 per cent and in the United Kingdom by 3.5 per cent. Demand for petrochemical feedstocks, primarily in Germany and Italy, fell as the sharp increase in crude oil prices raised the cost of petrochemical production. Gasoil and heavy fuel oil demand were also affected. German consumers in particular amassed sizeable stocks in 1998 and did not purchase heating oil at the higher price in 1999.

Based on preliminary data, world oil demand increased by 1.4 per cent from 1998 to 1999. The economic recovery in Asia fuelled a significant portion of this growth. Oil demand in China grew by 7 per cent in 1999 over its 1998 level and by 5.3 per cent in the rest of Asia.

Figure 4

Consumption of Oil Products by Sector in IEA Countries,1973-1998



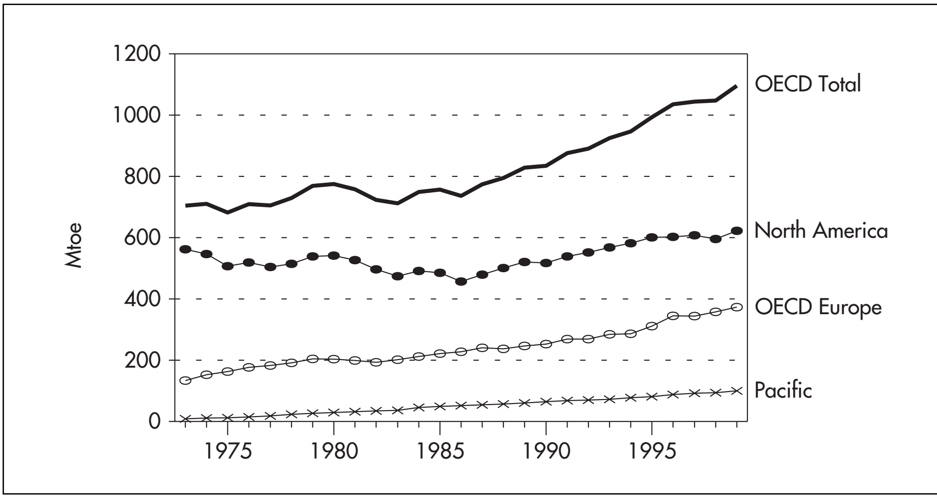
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

The growing demand for mobility in many IEA countries contributed to the increase in oil products consumption from 1,688 Mtoe in 1985 to 2,101 Mtoe in 1998. Recent increases in oil products consumption took place in the transport sector, as consumption declined in the residential/commercial sector and was largely unchanged in the industry sector. In 1998, the transport sector accounted for 56 per cent of total oil products demand, compared with 50 per cent in 1985. In the transport sector, the consumption of diesel and aviation fuels has risen steadily over the past five years. Gasoline consumption, however, has remained largely unchanged since 1990. The share of diesel increased from 26 per cent in 1990 to 28 per cent in 1998, while the share of gasoline in total oil products consumption fell from 55 per cent to 52 per cent over the same period.

Natural gas

Demand for natural gas in OECD countries grew by 4.6 per cent in 1999 over its 1998 level. The steady growth over the past several years reflected developments in gas infrastructure and greater penetration of gas for electricity generation. In OECD North America, demand increased by 4.5 per cent in 1999; demand rose by 6.2 per cent in OECD Pacific, and by 4.3 per cent in OECD Europe. The relatively large percentage increase in OECD Pacific was due to a sharp increase in demand in Korea (by 21.2 per cent) and to a steady increase in Japan (by 4.2 per cent), primarily for power generation. The expansion of gas-fired power generation also fuelled growth in gas demand in OECD Europe.

Figure 5
Natural Gas Demand in OECD Countries (by Region), 1973-1999



Note: 1 toe of gas is approximately 1.07 thousand cubic meters.
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

Coal

Electricity and heat generation account for more than 80 per cent of coal consumed in OECD countries. Coal demand has fallen considerably in OECD Europe from its peak of 468 Mtoe in 1985 to 316 Mtoe in 1999. Coal demand continues to increase, however, in OECD Pacific. In OECD North America, total coal demand increased by 5 Mtoe in 1999 from its 1998 level.

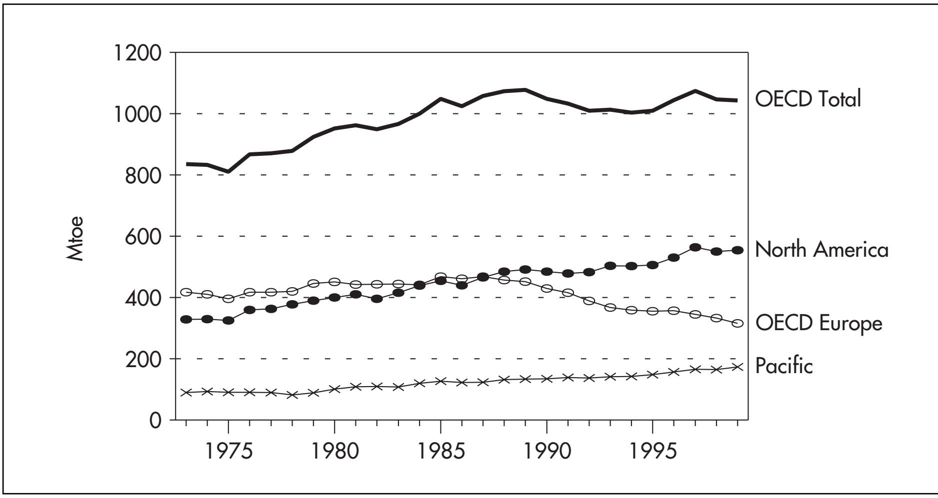
Electricity

Electricity consumption in OECD countries has grown considerably, largely in line with GDP growth (see Figure 23). Consumption was 663 Mtoe in 1998, growing by 2 per cent over its 1997 level; GDP in OECD countries grew by 2.1 per cent in the same year. The stagnant economy in Japan was the primary factor behind the marginal increase in OECD Pacific in 1998.

Energy Demand by Sectors

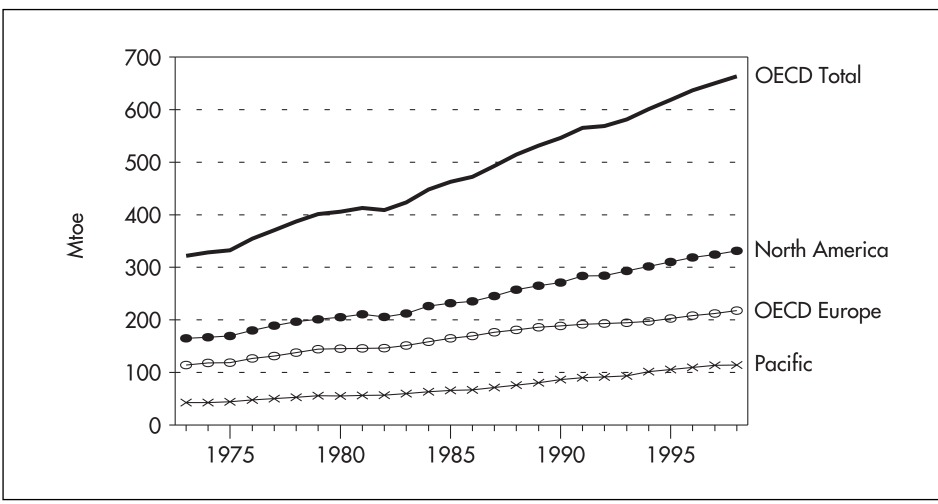
Total final consumption (TFC) in OECD countries was 3,467 Mtoe in 1998, roughly equivalent to its 1997 level. Final energy use fell in OECD Pacific by 2.7 per cent to 528 Mtoe, largely due to stagnant economic growth in Japan (GDP fell by 2.4 per

Figure 6
Coal Demand in OECD Countries (by Region), 1973-1999



Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

Figure 7
Electricity Demand (Final Consumption) in OECD Countries (by Region), 1973-1998



Note: 1 toe of electricity equals 0.01163 GWh.
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

cent in 1998 in the OECD Pacific region). TFC in OECD North America was 1,710 Mtoe in 1998, largely unchanged from 1997 despite strong economic growth (3.8 per cent). In OECD Europe, GDP grew by 2.8 per cent in 1998 relative to 1997, and TFC increased by 1.3 per cent reaching 1,230 Mtoe in 1998.

Table 2
Electricity Consumption
(Mtoe)

	1997	*1998*	*Annual Percentage Change*
Total OECD	650	663	2.0
North America	324	331	2.2
Europe	212	218	2.6
Pacific	114	114	0.6

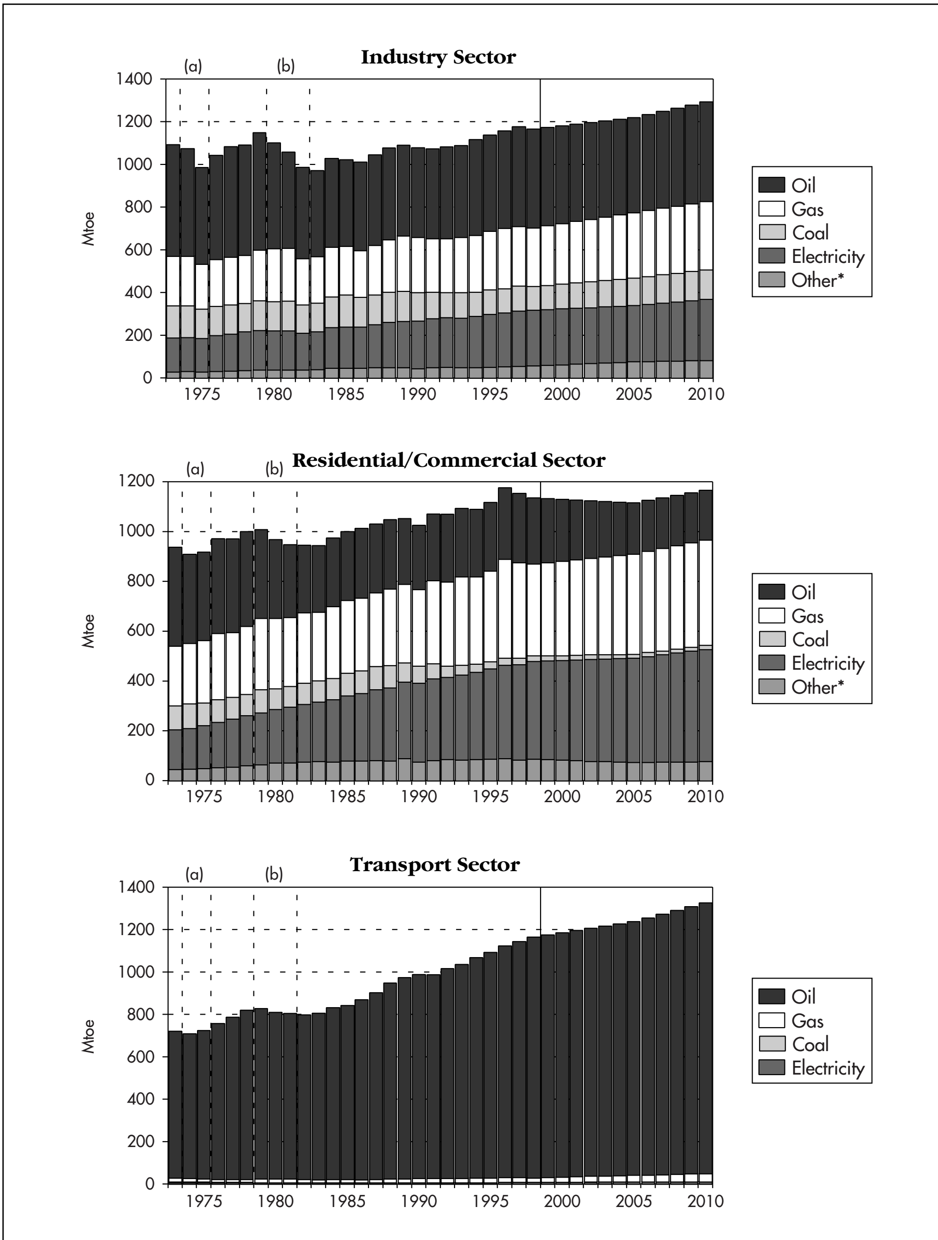
Table 3
Total Final Consumption in OECD Regions

	1997	*1998*	*Annual Percentage Change*
TFC Total			
Total OECD	3 475	3 467	-0.2
North America	1 718	1 710	-0.5
Europe	1 214	1 230	1.3
Pacific	543	528	-2.7
Industry			
Total OECD	1 176	1 166	-0.9
North America	529	522	-1.3
Europe	416	419	0.6
Pacific	232	225	-2.8
Residential/Commercial			
Total OECD	1 154	1 135	-1.6
North America	534	517	-3.2
Europe	461	465	0.7
Pacific	158	153	-3.1
Transport			
Total OECD	1 145	1 166	1.9
North America	655	671	2.4
Europe	337	346	2.8
Pacific	153	149	-2.3

Industry Sector

OECD energy demand in the industry sector declined by some 1 per cent between 1997 and 1998. In 1998, industrial energy demand fell significantly in the OECD Pacific, by 2.8% over its 1997 level due to Japan's stagnant economy. Demand fell by 1.3% to 522 Mtoe in OECD North America. Total final consumption increased only marginally to 419 Mtoe in OECD Europe.

Figure 8
Final Consumption by Sector and by Fuel in OECD Countries, 1973-2010



Note: Korea, Mexico, Norway and Poland are excluded from 1999 to 2010.
* includes geothermal, solar and wind.
(a) corresponds to the first oil shock (end 1973) and macro-economic recession induced by this shock.
(b) corresponds to the second twin oil shock (early 1979 and end 1980) and the macro-economic recession induced by this double shock.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and country submissions.

Electricity demand for industry in OECD countries grew steadily at an annual average rate of 2.3 per cent from 1990 to 1998, reaching 262 Mtoe in 1998. From 1997 to 1998 electricity consumption increased in OECD North America by 1.4 per cent to 116.9 Mtoe, but fell slightly in OECD Pacific in 1998 to 52.7 Mtoe, reflecting the region's economic performance. Industrial consumption of oil fell by 1.1 per cent in OECD countries, reaching 461 Mtoe in 1998. Gas consumption also declined to 275 Mtoe. Although coal consumption had not changed significantly since 1994, it also dropped by 4.2 per cent from 1997 to 111 Mtoe in 1998.

Residential/Commercial Sector

Mild winters over the past several years have driven declines in energy consumption in the residential/commercial sector in OECD countries. After peaking in 1996, when winter was very cold in many countries, final consumption has fallen for two consecutive years, reflecting the milder weather conditions. Electricity consumption grew steadily at an annual average rate of 3 per cent from 1990 to 1998 to 393 Mtoe in 1998. This growth is due to an increse in demand for electrical appliances in the residential/commercial sector, where the intensive use of these appliances has more than offset efficiency improvements.

Transport Sector

Total final consumption in the transport sector in OECD countries increased at an annual average rate of 2.3 per cent from 1990 to 1,166 Mtoe in 1998. Total final consumption in the OECD Pacific region, however, declined by 2.3 per cent in 1998 reflecting stagnant economic growth in the region. Although there are many examples of energy efficiency improvements in this sector, the increasing demand for transport has offset these efficiency gains. Oil demand has accounted for 97 per cent of total energy demand in this sector throughout the past decade.

ENERGY SUPPLY

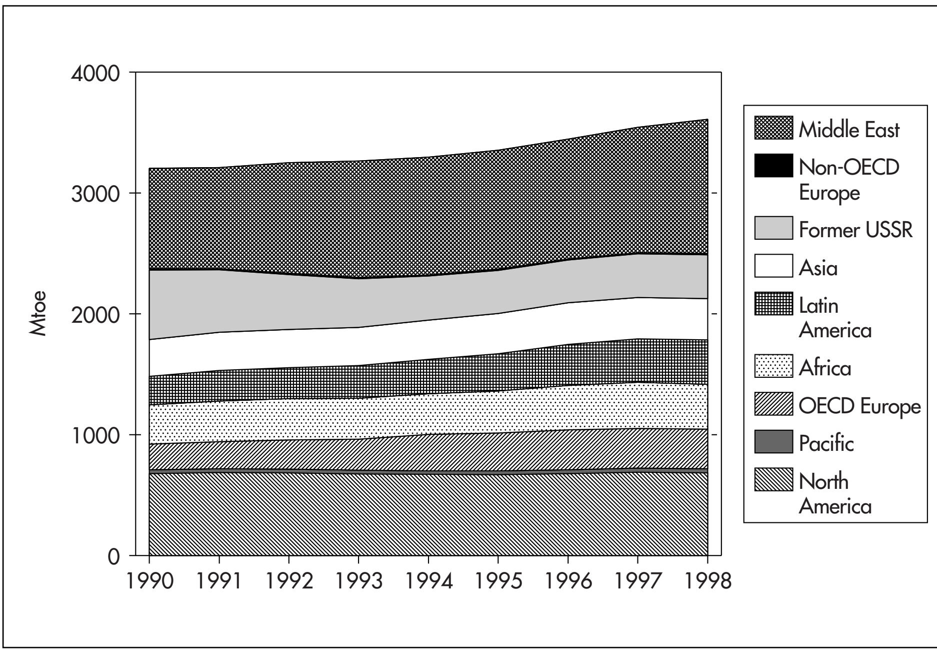
Oil

From 1990 to 1998, Latin America increased its crude oil production by 55% from 237 Mtoe to 367 Mtoe, OECD Europe production increased by 53% from 213 Mtoe to 327 Mtoe, and production in the Middle East increased by 34% from 831 Mtoe to 1,111 Mtoe. African oil production increased by 15% from 323 Mtoe to 372 Mtoe over the same period. Oil production in the former Soviet Union, however, fell by 37% from 574 Mtoe in 1990 to 363 Mtoe in 1998. Production in OECD North America rose marginally, by some 20 Mtoe from 1990 to 1998.

World crude oil production grew by 1.9% from 1997 to 3,601 Mtoe in 1998. Almost all this recent increase came from the Middle East as Iraq increased production under the UN oil-for-food programme.

Preliminary data indicate that world crude oil production fell by 1.9 per cent from 1998 to 1999. OPEC reduced its production by 4.5 per cent reflecting their February 1999 agreement to curtail production. Production in OECD North America fell by 3.7 per cent in response to low crude oil prices in 1998, which reduced upstream spending and caused lower levels of routine maintenance, workover and infill development drilling. There were also some shut-ins, particularly at heavy-oil fields in Western Canada and California, and at low-productivity stripper wells in the US. Since oil production for the rest of the OECD countries stayed at the same level as in the previous year, overall OECD production dropped by only some 2 per cent in 1999. Oil production by non-OECD, non-OPEC suppliers increased slightly in 1999 over its 1998 level.

Figure 9
World Oil Production, 1990-1998

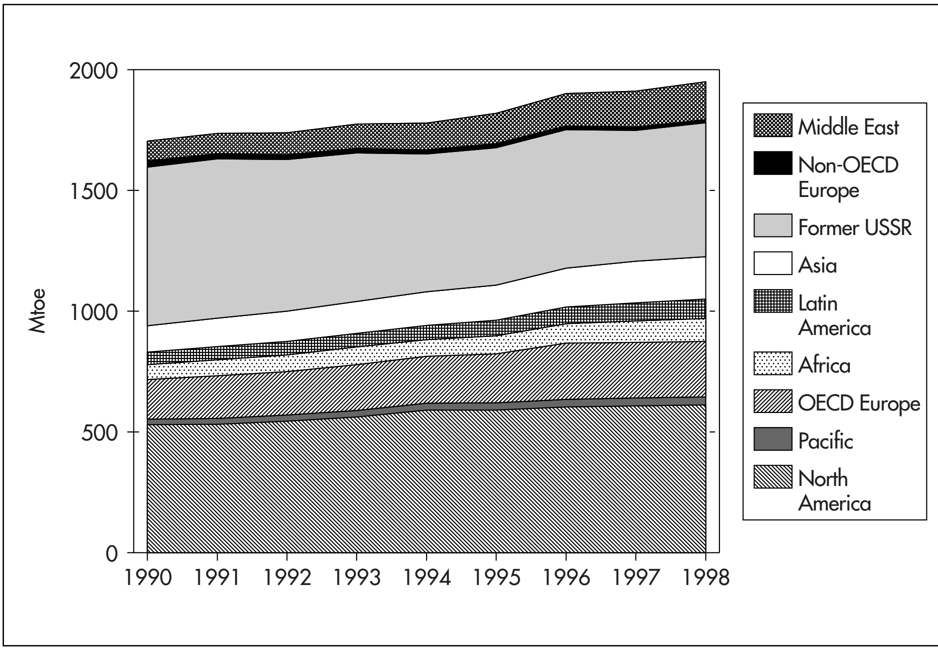


Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and *Energy Statistics of Non-OECD Countries*, IEA/OECD Paris, 2000.

Natural Gas

World natural gas production grew by 2 per cent from 1997 to 1,949 Mtoe in 1998. While gas production in the former Soviet Union (FSU) fell from 656 Mtoe in 1990 to 541 Mtoe in 1997, it increased to 554 Mtoe in 1998. The FSU share in world production fell from 38.5 per cent in 1990 to 28.4 per cent in 1998, mainly as a result of the 20% drop in internal gas consumption. North America increased gas production from 531 Mtoe in 1990 to 613 Mtoe in 1998 and has exceeded production levels in the FSU since 1994. OECD North America holds the largest share, some 30 per cent, of world gas production. Middle East production increased by over 90 per cent from 1990 to 1998, while production increased in Asia and Latin America by some 60 per cent.

Figure 10
World Natural Gas Production, 1990-1998



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and *Energy Statistics of Non-OECD Countries*, IEA/OECD Paris, 2000.

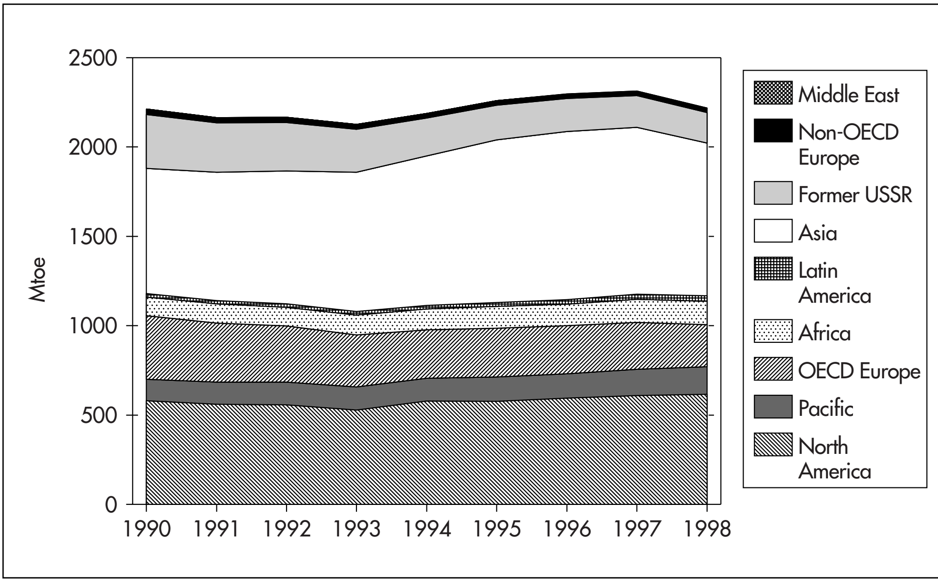
Coal

After falling slightly in the early 1990s, world coal production increased from 2,127 Mtoe in 1993 to 2,313 Mtoe in 1997, driven mainly by substantial production increases in Asia (778 Mtoe to 935 Mtoe) and in North America (529 Mtoe to 609 Mtoe). These two regions combined account for two-thirds of total world production. Coal production fell in OECD Europe (291 Mtoe in 1993 to 263 Mtoe in 1997) and in the former Soviet Union (241 Mtoe to 178 Mtoe). In 1998, world coal production fell by 95 Mtoe to 2,218 Mtoe, due to significant declines in Asian production. Restructuring of the coal industries in OECD Europe and the FSU caused further declines in these regions in 1998.

Electricity

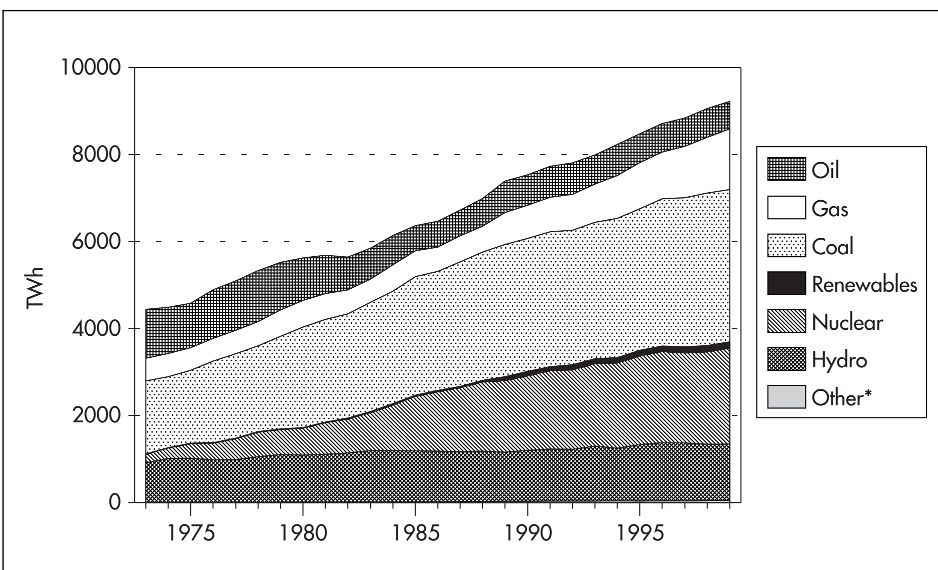
Total electricity generated in OECD countries increased by 1.8 per cent from 1998 reaching 9,223 TWh in 1999. Gas-fired electricity generation and nuclear power rose

Figure 11
World Coal Production, 1990-1998



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and *Energy Statistics of Non-OECD Countries*, IEA/OECD Paris, 2000.

Figure 12
OECD Electricity Supply by Fuel, 1973-1999



* includes geothermal, solar and wind.
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

by 3.6 per cent or 77 TWh each. Electricity generated by oil declined by 4.9 per cent or 33 TWh, reflecting changes in relative fuel prices. Electricity generated by hydro and by coal was stable between 1998 and 1999. Electricity generated by renewable sources increased by 5 per cent to 150 TWh in 1999, but its share in total generation remained marginal (1.6 per cent). In 1999, the shares in electricity generation in the OECD were as follows: coal 38 per cent, nuclear 24 per cent, gas 15 per cent, hydro 14 per cent and oil 7 per cent.

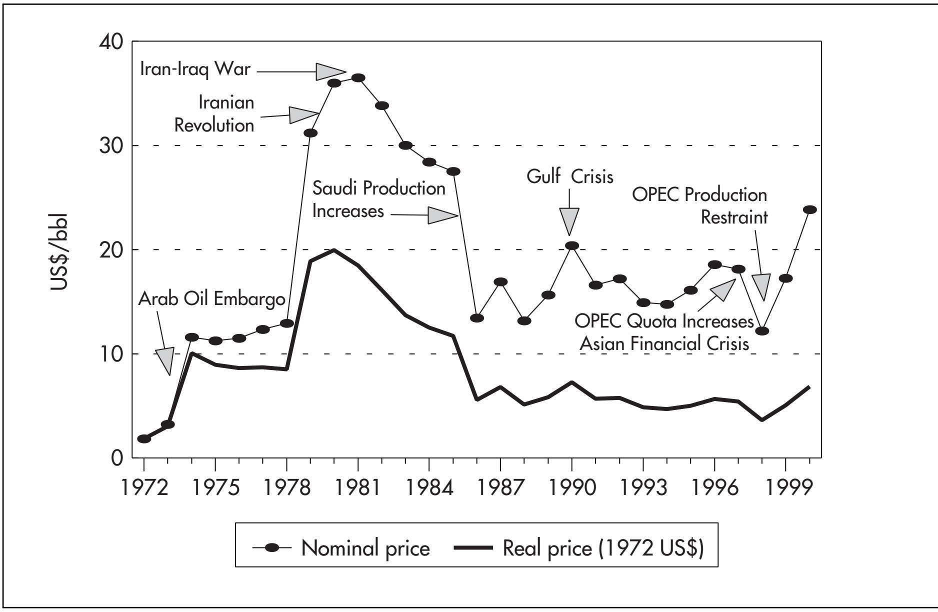
ENERGY PRICES

International crude oil prices were extremely volatile in 1999 and 2000. After a sustained rally which commenced in mid-February 1999 and lasted into early 2000, prices fell sharply in advance of OPEC's meeting at the end of March 2000. Since then, prices have ebbed and flowed on speculation about OPEC action or inaction, but against a steady backdrop of low inventories. OPEC's experiment with a "price band" approach to micro-managing the oil market had a rough three months, with speculators first testing the $22 per barrel lower bound (with some help from an Iraqi production push). Prices then topped the $28 per barrel upper bound, and, by mid-2000, the direction of prices was very uncertain. Product markets remained tight while additional production relieved some of the tightness in crude markets.

The dominant event for oil prices in the last two years was the meeting in the Hague in February 1999 which established support at the Head-of-State level for a new agreement with much better compliance to limit production. The new administration in Venezuela and improved Saudi-Iranian relations provided the cement for the agreement, which was broadened to include the other seven OPEC states (Iraq was not included), as well as Mexico, Oman and Norway. A recovery in Asian demand and a continued very strong economy in the US worked with the producer restraint to bring down excess inventories that had built up as a result of OPEC overproduction in 1998. However, with strong demand and restricted supply, and with heavy stocking by consumers in advance of Y2K, the stockdraw left primary inventories at historical lows by the end of 1999. Since the Y2K stocks were not used in the event, they served to hold down the stockdraw in the first quarter of 2000. Nonetheless, product inventories in the US and Europe were quite low going into the summer driving season, requiring a higher-than-normal proportion of daily demand for gasoline to be met from refining rather than from stocks. The need to maximise gasoline production, in turn, limited the possibility of building heating oil inventories for the 1999/2000 winter.

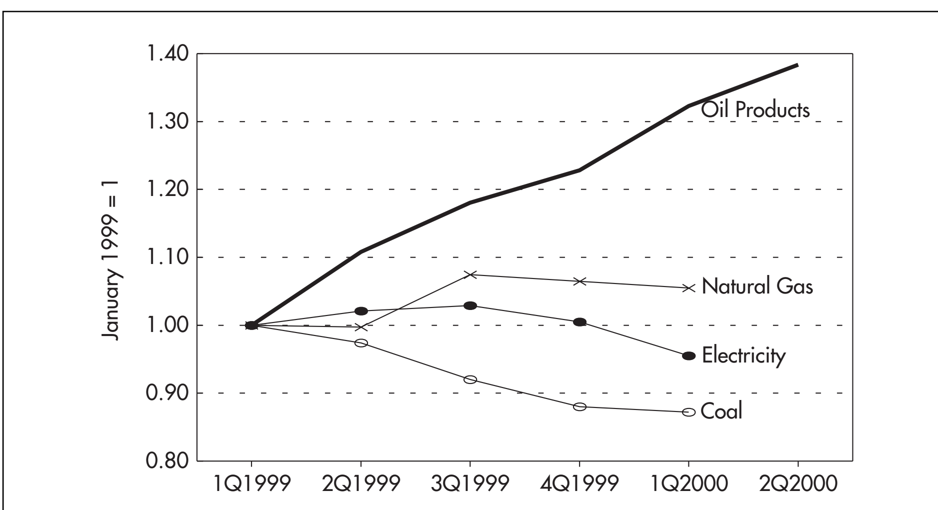
Higher oil prices over the past two years have had less of an effect on other fuel prices than did the high prices experienced during the second oil shock of 1979/81. Reasons for this include substitution away from oil in the industrial and residential/commercial sectors which has enhanced competition among fuels, and higher taxes on fuels which have dampened the effect of crude oil price changes on final products prices. While the price of natural gas did rise in 1999, the increase was less than for the prices of oil. The price of coal declined both in absolute terms and relative to the price of oil. Electricity prices did not change considerably in OECD countries in 1999.

Figure 13
Crude Oil Prices, 1972-2000*



* 1 January to 30 april 2000.
Sources: 1972-1986 Arabian Light prices from the Oil Economists' Handbook. 1987-1996 Dubai prices from the OPEC Annual Statistical Bulletin 1996. January 1997 to 30 April 200 Dubai prices from the Oil Market Price Review, IEA.

Figure 14
Indexed Fuel Prices, January 1999 to March 2000



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

The impact of rising crude oil prices on the price of oil products and on other fuels varied among IEA countries, reflecting various factors including economic growth rates, stock levels, tax levels, market structure, the degree of competition, exchange rates, and climatic conditions.

Oil and Oil Products

On a quarterly basis, the price of Dubai crude oil more than doubled from US$ 11 in the first quarter of 1999 to US$ 24.40 in the first quarter of 2000. Although the price increase was less than that which occurred during the second oil shock (from US$ 13.3 in January 1979 to US$ 34 in October 1981), the price rise occurred over a shorter time period.

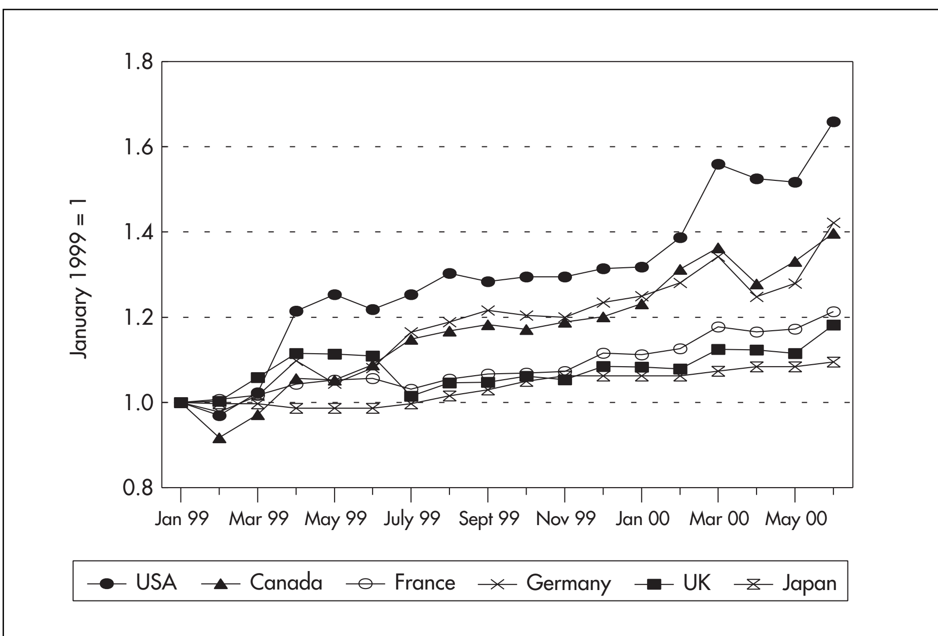
The aggregate price of oil products increased by 33 per cent between the first quarter of 1999 and the first quarter of 2000.

From January 1999 until the OPEC agreement on 29 March 2000, which increased crude production targets by 1.45 mb/d with effect from 1 April, gasoline prices increased 56 per cent in the US, 42 per cent in Germany, 35 per cent in Canada, 18 per

Figure 15

Gasoline Price Trends in Selected IEA Countries, January 1999-June 2000

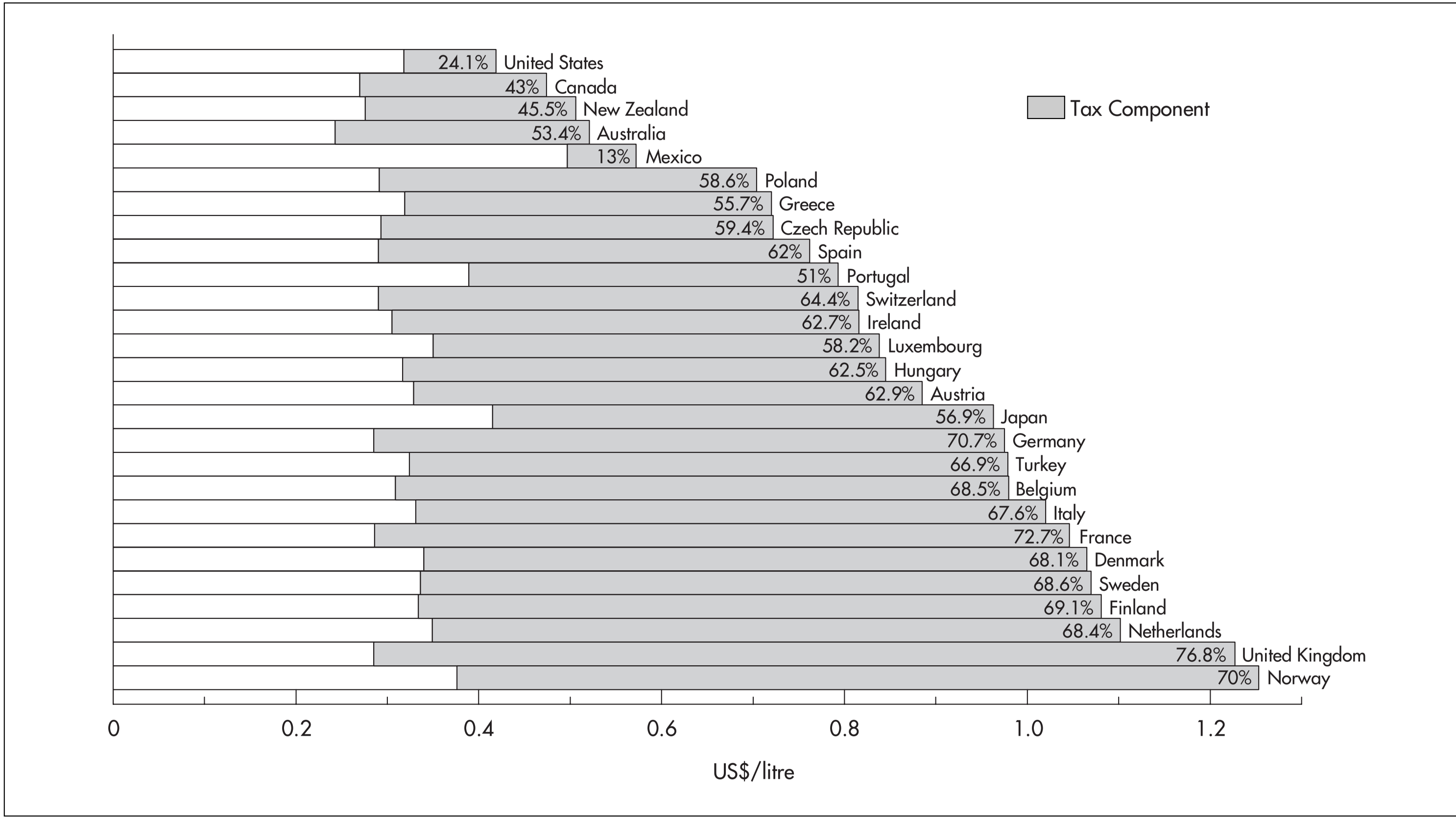
(Indexed price based on national currencies)



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

Figure 16

Gasoline Prices and Taxes in OECD Countries, First Quarter 2000



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

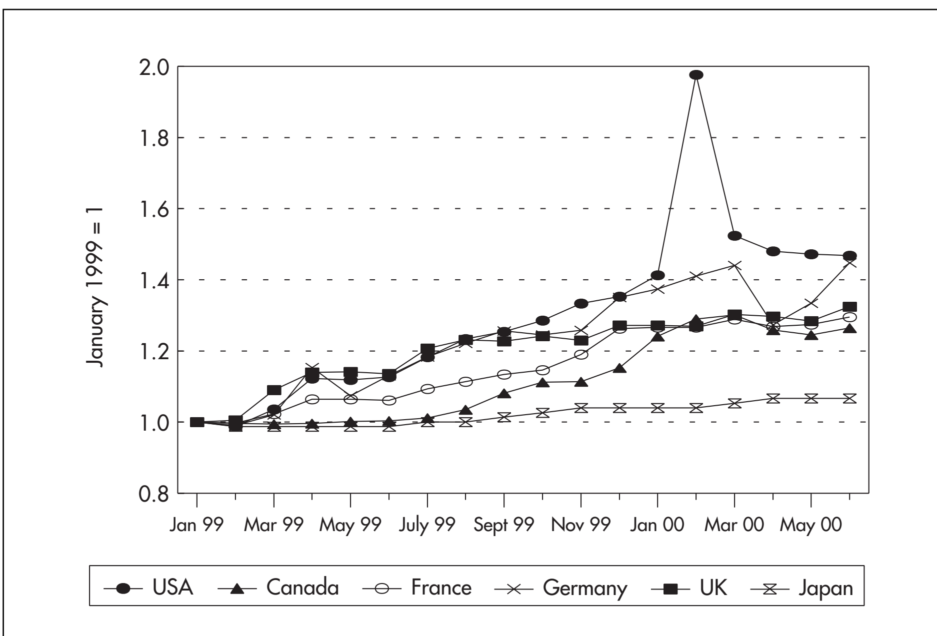
cent in France, 12 per cent in the UK and 7 per cent in Japan. Relatively low gasoline taxes in the US are mainly responsible for the higher percentage increase in gasoline prices there (31 per cent on regular unleaded gasoline in the 4th quarter of 1999), but weak inventories and limited availability of new "reformulated" gasoline were also factors. Despite Japan's lower gasoline tax, the increase in the end-user price of gasoline was less in Japan (57 per cent on regular unleaded gasoline price in the 4th quarter of 1999) than in the UK (79 per cent) or in France (75 per cent) on unleaded (95RON) gasoline in the 4th quarter of 1999. In Japan, stagnant economic growth kept product stocks high, and stiff competition among Japan's numerous gas stations made it difficult to raise the price of gasoline. In addition, long-term oil import contracts and higher transportation costs, which characterise the Japanese oil market, tend to dampen the impact of short-term crude oil price changes on end-use prices. The appreciation of the Yen against the US dollar also helped to soften the impact.

In many countries the tax on diesel fuel is less than on gasoline (Figure 18), and the price of diesel tends to be more responsive to changes in crude oil prices. A colder-than-normal winter in 1999/2000 and refinery problems contributed to the sharp rise in diesel prices in the US by 54 per cent between January 1999 and March 2000. On the other hand, the price of diesel rose by only 5 per cent in Japan, because of stagnant economic growth which affected the use of commercial vehicles more than private vehicles. The share of tax in the price of diesel fuel was 43 per cent in Japan

Figure 17

Diesel Price Trends in Selected IEA Countries, January 1999-June 2000

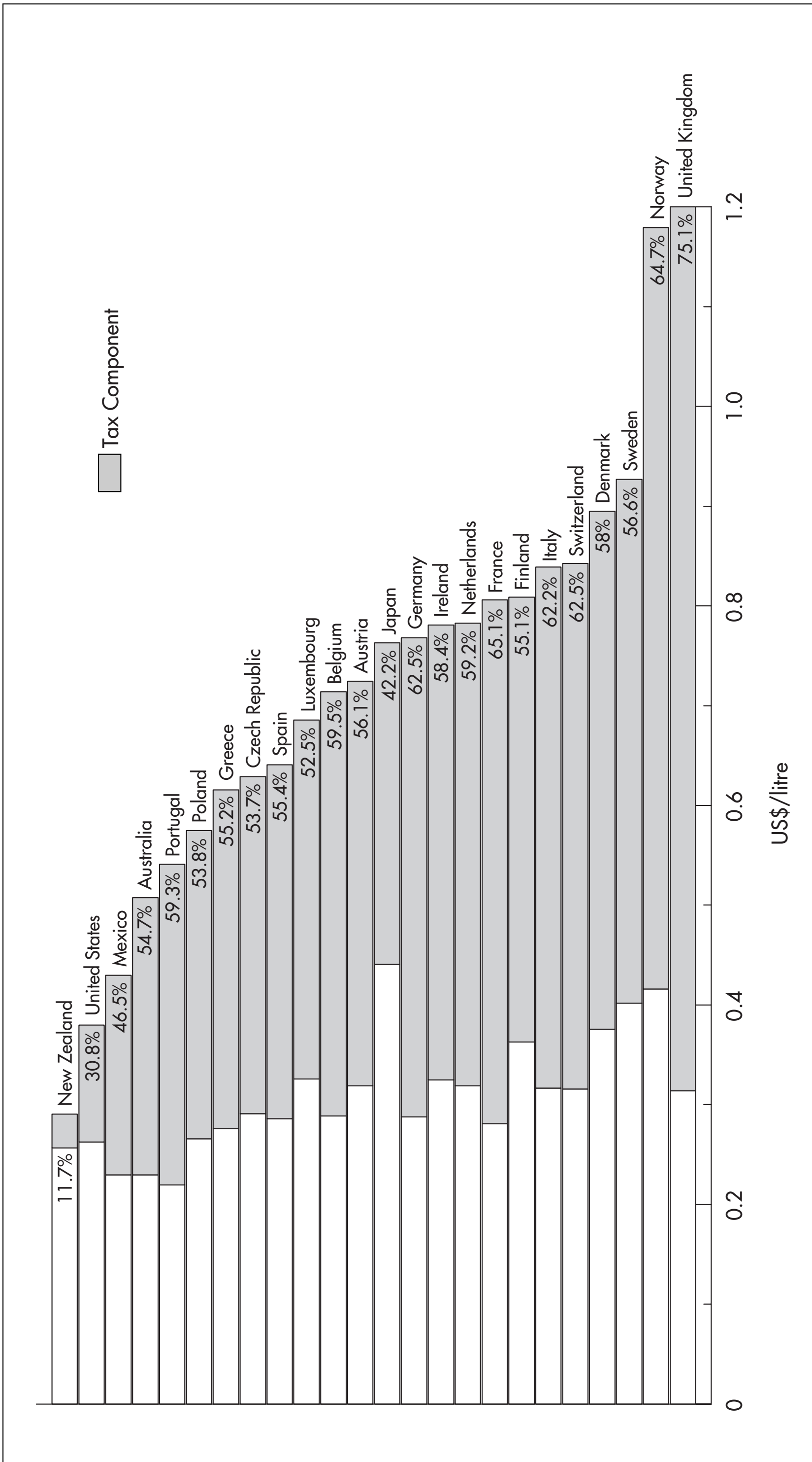
(Indexed price based on national currencies)



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

Figure 18

Automotive Diesel Prices and Taxes in OECD Countries, First Quarter 2000



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

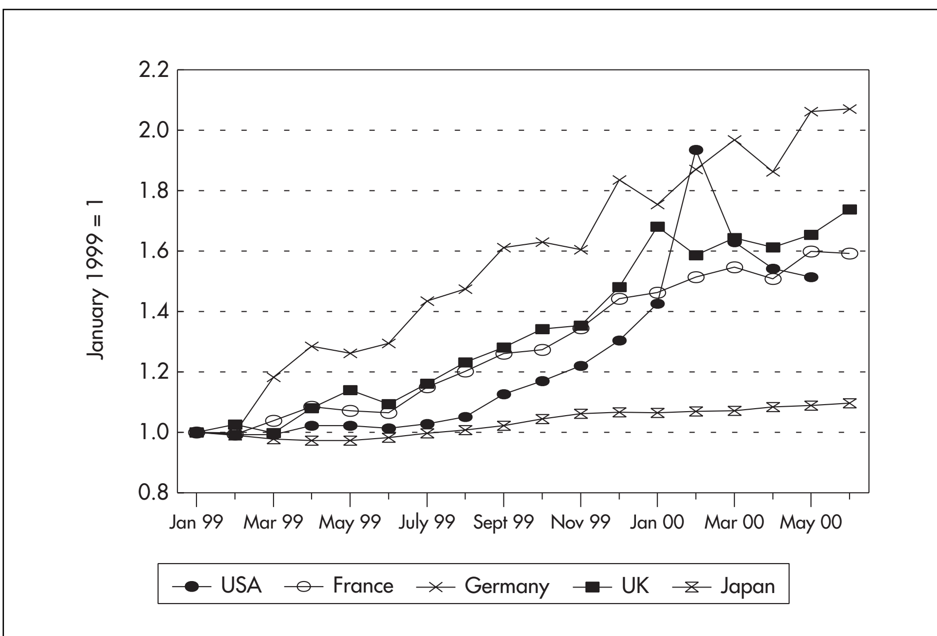
and 35 per cent in the US in the 4th quarter of 1999. Since April 2000, automotive diesel prices have not risen as fast as gasoline prices in OECD countries, except in Germany, where the market for diesel is closer than the market for gasoline.

Heating oil prices have increased dramatically in France, Germany, the US and the UK over the past year and a half. Taxes are lower on heating oil than on gasoline and diesel, so they have less of a dampening effect on oil price changes. In Japan, where the tax was much lower than in other countries (about 5 per cent in Japan compared with 40 to 80 per cent in other countries in the 4^{th} quarter of 1999), heating oil prices did not rise significantly because a relatively milder winter and inter-fuel competition for space heating dissuaded suppliers from raising the price of heating oil. Heating oil prices in the US peaked in March 2000, in response to tight stocks, unscheduled maintenance, unseasonably high natural gas prices and a cold winter, then fell as demand subsided seasonally.

Natural Gas

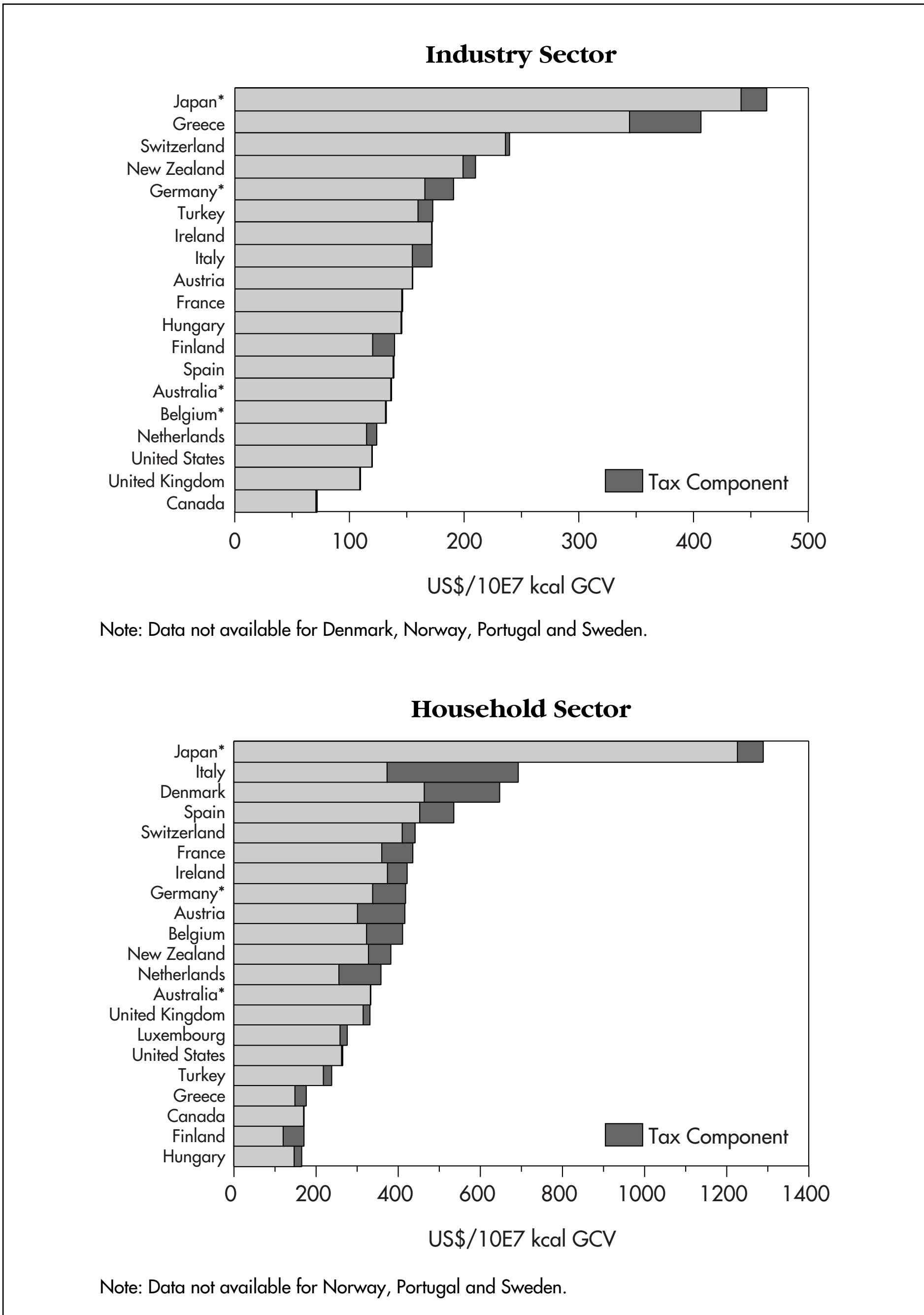
The average price of gas in IEA countries increased by only some 6 per cent from the first quarter of 1999 to the first quarter of 2000. This increase was much less

Figure 19
Space Heating Oil Price Trends in Selected IEA Countries, January 1999-April 2000
(Indexed price based on national currencies)



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

Figure 20
Gas Prices in IEA Countries, 1998



* 1997
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

than the increase in the price of crude oil, due primarily to the fact that natural gas prices are often subject to long-term contracts in many countries. In comparison, gas prices increased by 33 per cent between 1Q 1979 and 3Q 1981.

Electricity

Electricity prices in IEA countries have not changed significantly over the past two years. Inter-fuel competition has worked to restrain prices, and the share of oil-based generation has declined. The real price of electricity in IEA countries was fairly stable between 1Q 1999 and 1Q 2000, while it increased quite significantly after the second oil shock, by 26 per cent between 1Q 1979 and 3Q 1981.

Coal

Weak coal demand led to a decline in coal prices in IEA countries in 1999 and into the early months of 2000. The average price declined by 13 per cent between 1Q 1999 and 1Q 2000, while, in comparison, it rose by 11.4 per cent between 1Q 1979 and 3Q 1981.

ENERGY INTENSITY AND CO_2 EMISSIONS

Energy Intensity

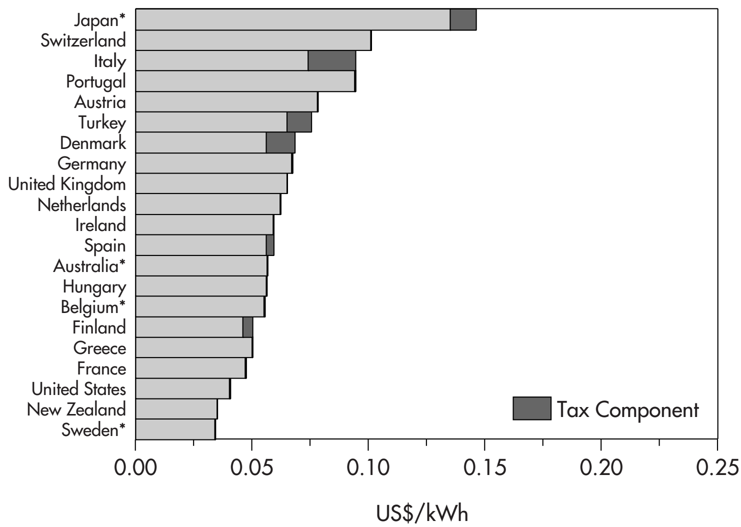
In 1998, growth in total primary energy supply (TPES) was less than GDP growth in the IEA economies, implying a decline in energy intensity. Energy intensity measured as the ratio of TPES to GDP, was 0.21 toe/thousand 1990 US$ in 1998, a decline of 5.4 per cent since 1990, TPES per capita in IEA countries increased by an annual average of 1 per cent from its 1990 level to 5.1 toe per capita in 1998.

Over the past two decades the ratio of final energy consumption to GDP in IEA countries declined in all sectors, although the rate of decline was more pronounced in the industry and residential/commercial sectors than in the transport sector. Despite low fuel prices in 1998, energy intensity still declined in all three sectors.

The modest overall decline in energy intensity does not imply that energy efficiency improved only marginally across sectors. On the contrary, there have been significant energy-efficient improvements in many areas, but the energy demand increase tends to offset the efficiency gains. Better insulation and energy-efficient technologies and processes have resulted in significant efficiency improvements in the residential/commercial and the industry sectors. Many IEA countries have actively taken steps to improve energy efficiency and to reduce greenhouse gas emissions as described later in this book, but further efforts are needed to meet the Kyoto targets.

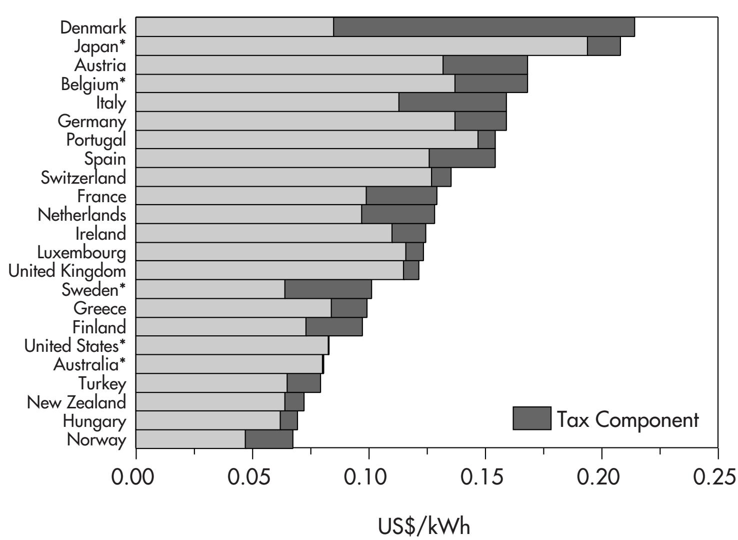
Figure 21
Electricity Prices in IEA Countries, 1998

Industry Sector



Note: Ex-tax price for Australia and the United States.
Neither 1997 nor 1998 data are not available for Canada, Luxembourg and Norway.

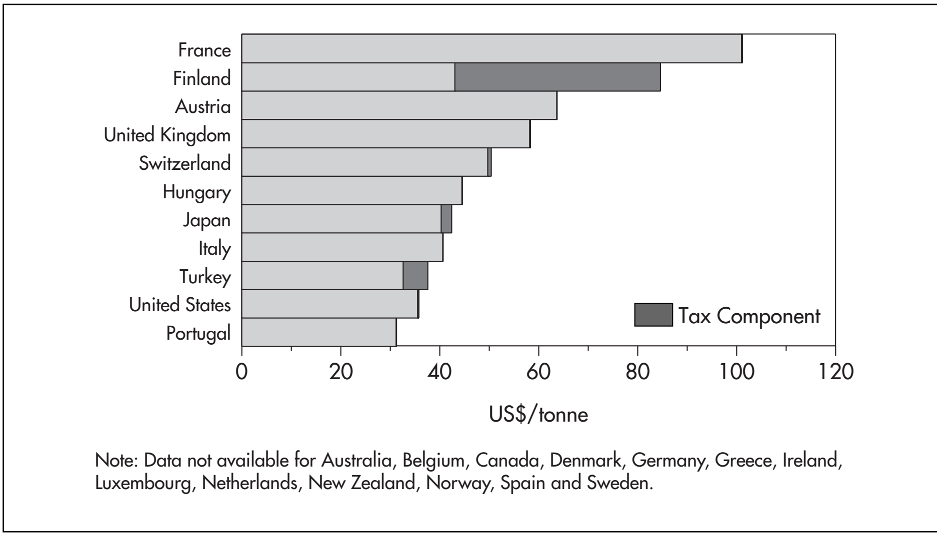
Household Sector



Note: Ex-tax price for Australia and the United States.
Neither 1997 nor 1998 data are available for Canada.

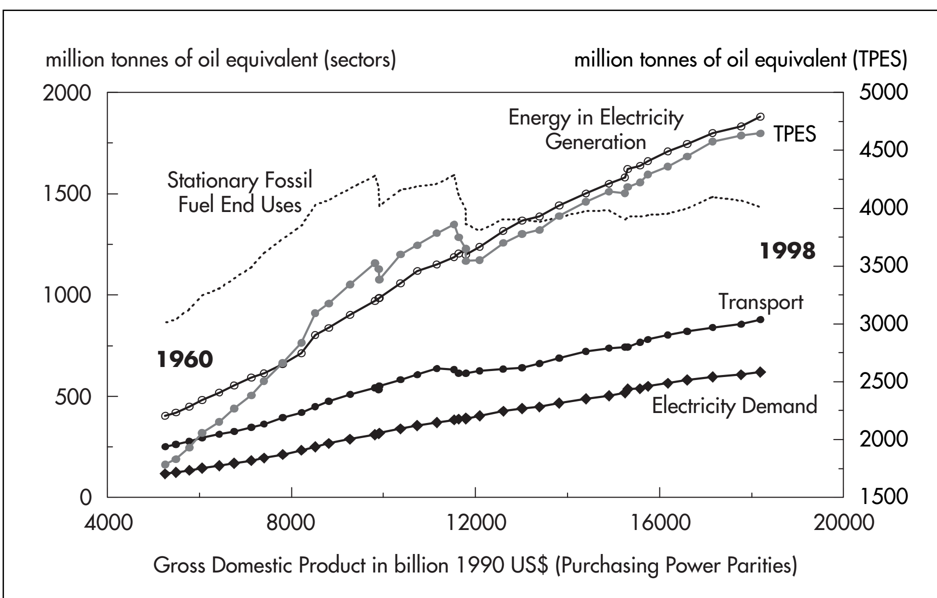
* 1997.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

Figure 22
Steam Coal Prices in IEA Countries, 1998
Industry Sector



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

Figure 23
Energy Demand in IEA Countries: a Sectoral View (1960-1998)

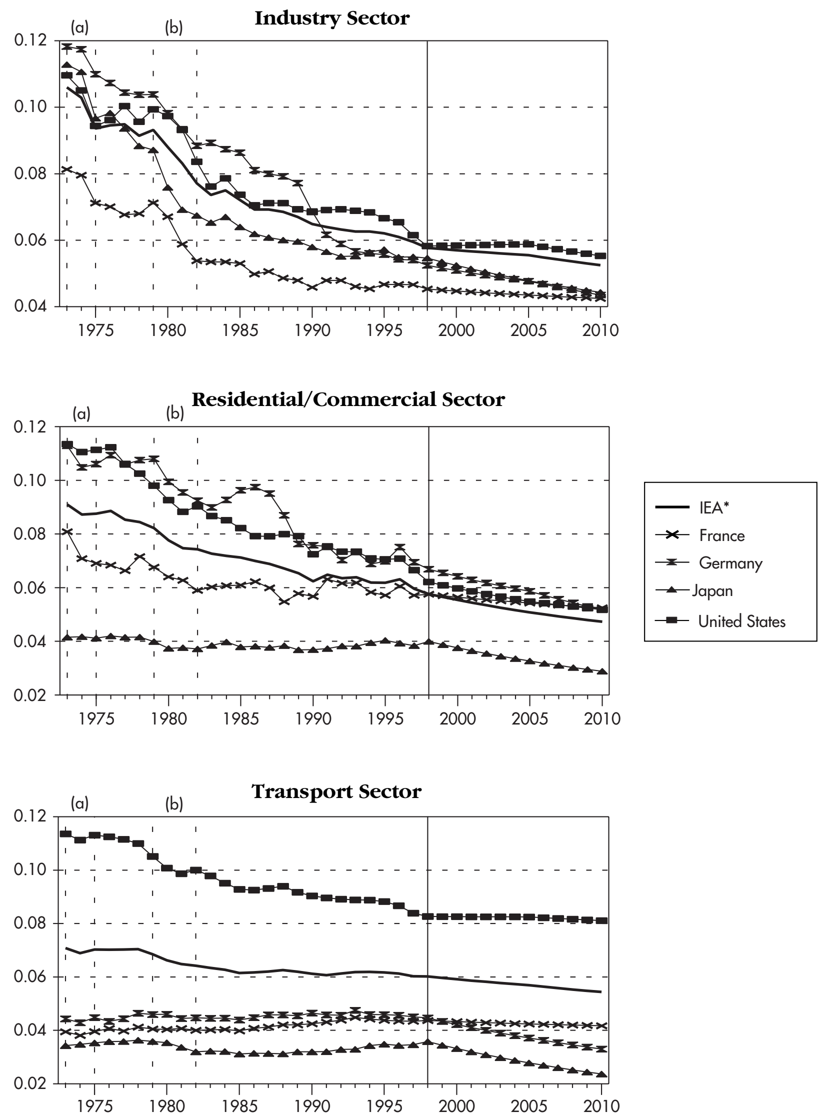


Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and *National Accounts of OECD Countries*, OECD Paris, 2000.

Figure 24

Final Consumption by Sector per GDP (PPP) in Selected IEA Countries, 1973-2010

(Toe per thousand US$ at 1990 prices and purchasing power parities)



* excluding Norway from 1999 onwards.

(a) corresponds to the first oil shock (end 1973) and macro-economic recession induced by this shock.

(b) corresponds to the second twin oil shock (early 1979 and end 1980) and the macro-economic recession induced by this double shock.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and *National Accounts of OECD Countries*, OECD Paris, 2000.

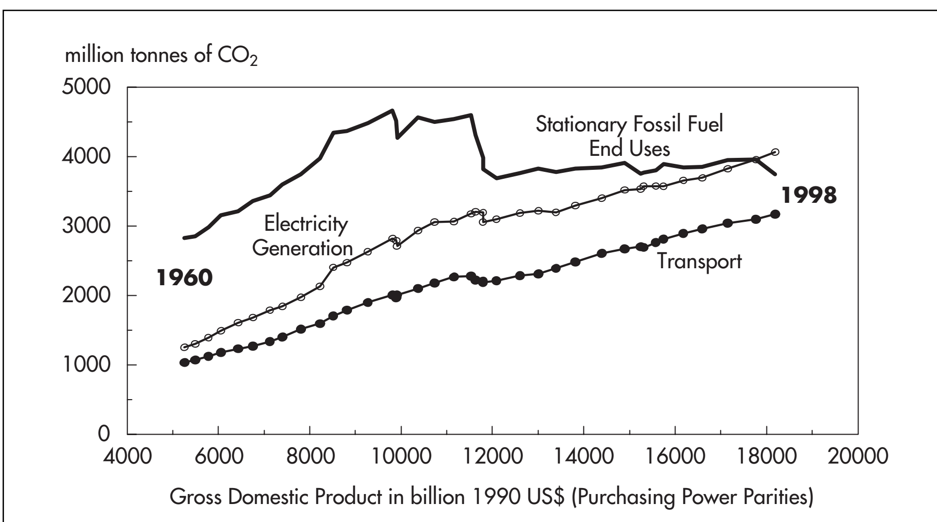
CO_2 Emissions

Energy-related CO_2 emissions in IEA countries reached 11 billion tonnes in 1998, up 7.8% from their 1990 level. While energy intensity and carbon intensity have both declined over the past three decades in OECD countries and are projected to continue to decline (Figure 26), only modest reductions have been achieved through energy efficiency improvements and substitution away from oil and coal toward gas. Natural gas emits some 40 per cent less CO_2 than coal and some 25 per cent less CO_2 than oil to generate one unit of energy. However, conversion to gas could increase CO_2 emissions if it replaces fuels such as hydro and nuclear power.

Energy-related CO_2 emissions per GDP (Figure 27) vary significantly among IEA countries. Exceptionally high CO_2 emissions per GDP in Hungary and those of Turkey are the result of using exchange rates which do not reflect purchasing power parity. Low emitters, including France, Norway, Sweden and Switzerland, have relatively high shares of hydro and nuclear power in their energy mix. Policies aimed at improving energy efficiency also have high priority in many countries where CO_2 emissions per GDP or per capita are low. Reasons for the observed disparity in CO_2 emissions per GDP among countries include: industrial structure; climate; structure of the fuel supply and consumption (Figure 29); fuel prices; economic growth rates; per-capita income levels and the rate of use of public transport. This disparity suggests that policies to reduce CO_2 emissions should be tailored to each country.

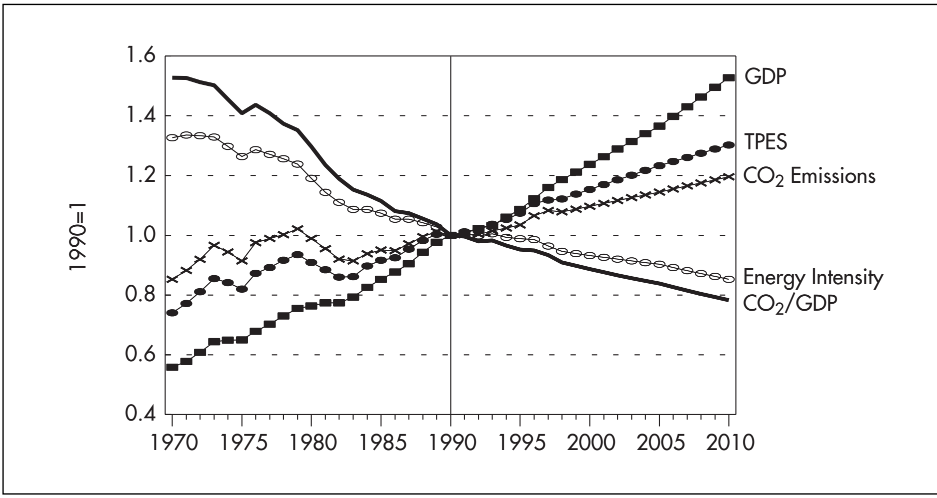
Figure 25

Energy-Related CO_2 Emissions Relative to GDP (PPP) in IEA Countries, 1960-1998



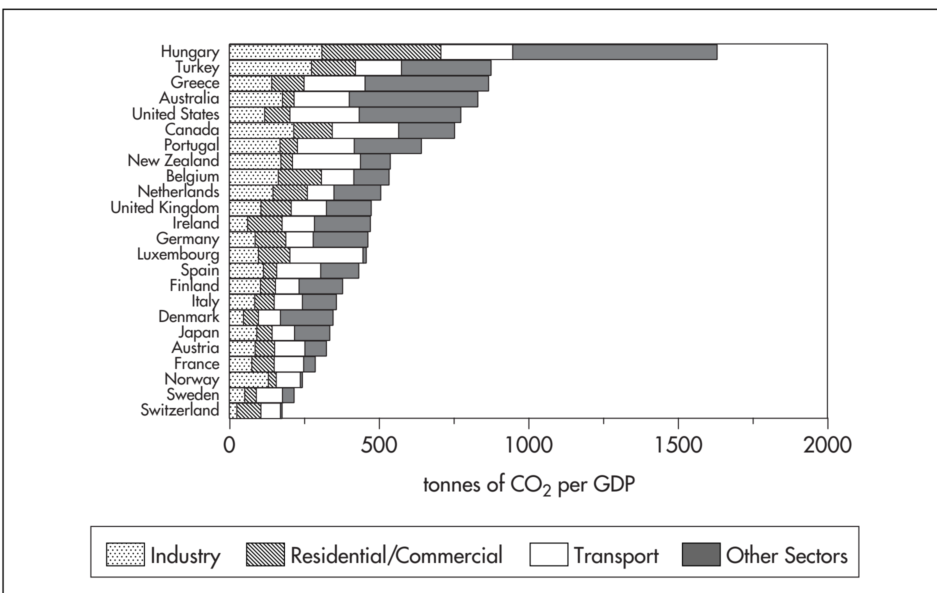
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and *National Accounts of OECD Countries*, OECD Paris, 2000.

Figure 26
Key Factors Affecting Energy-Related Carbon Emissions in Industrialised Countries, 1970-2010



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000; *National Accounts of OECD Countries*, OECD Paris, 2000 and country submissions.

Figure 27
CO_2 Emissions per GDP by Sector in IEA Countries, 1998
(CO_2 Emissions/GDP using 1990 prices and exchange rates)



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and *National Accounts of OECD Countries*, OECD Paris, 2000.

Energy-related CO_2 emissions per capita also vary among IEA countries (Figure 28). Exceptionally high per capita oil consumption in Luxembourg reflects the fact that drivers from neighbouring countries refuel there to take advantage of cheaper petrol due to low taxes.

The fuel mix also affects CO_2 emissions among IEA countries quite significantly (Figure 29). Countries that depend heavily on fossil fuels, in particular coal, emit more CO_2 per capita and per GDP, while countries with relatively higher shares of nuclear and renewable fuels emit less.

In the 1990s, CO_2 emissions in IEA countries declined in the industry sector, remained largely unchanged in the residential/commercial sector, and steadily increased in the transport sector. Climate has the largest effect on CO_2 emissions in the residential/commercial sector, which peaked in 1996 because of cold weather. The trends suggested in Figure 30 indicate that extraordinary efforts are needed to curtail CO_2 emissions in the residential/commercial and transport sectors, which accounted for 42 per cent of total emissions in IEA countries in 1998.

Table 4

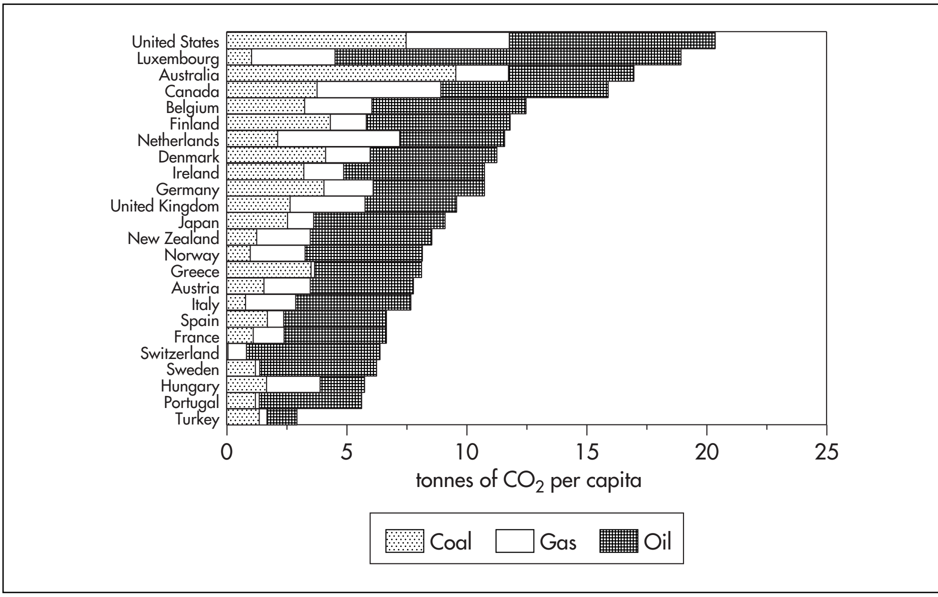
Energy-Related CO_2 Emissions Excluding International Marine Bunkers

(Million tonnes)

	1990	*1998*	*2005*	*% Increase from 1990 to 2005*	*2010*	*% Increase from 1990 to 2010*
Canada	424	480	530	25	559	32
United States	4 885	5 467	6 215	27	6 596	35
North America	**5 309**	**5 947**	**6 745**	**27**	**7 155**	**35**
Australia	263	318	351	34	371	41
Japan	1 062	1 147	1 105	4	1 074	1
New Zealand	25	32	32	26	37	47
Pacific	**1 350**	**1497**	**1 488**	**10**	**1 482**	**10**
Austria	59	62	62	4	64	9
Belgium	109	127	114	4	120	10
Denmark	53	60	57	7	61	15
Finland	54	61	69	27	70	28
France	378	389	..	..	481	27
Germany	981	876	858	-13	861	-12
Greece	72	85	111	54	137	90
Hungary	68	58	58	-14	59	-13
Ireland	33	40	44	33	48	46
Italy	408	435	445	9	464	14
Luxembourg	11	8	9	-13	9	-16
Netherlands	161	181	197	22	209	30
Norway	30	36	..	..	37	26
Portugal	41	56	58	40	63	51
Spain	215	261	..	..	..	..
Sweden	53	55	58	10	55	4
Switzerland	44	45	41	-7	41	-8
Turkey	138	189	345	149	459	232
United Kingdom	585	567	607	4	617	5
IEA Europe	**3 496**	**3 591**	**..**	**..**	**..**	**..**
Excl. France, Norway and Spain	**2 873**	**2 904**	**3 133**	**9**	**3 336**	**16**
IEA TOTAL	**10 155**	**11 036**	**..**	**..**	**..**	**..**
Excl. France, Norway and Spain	**9 532**	**10 349**	**11 367**	**19**	**11 973**	**26**

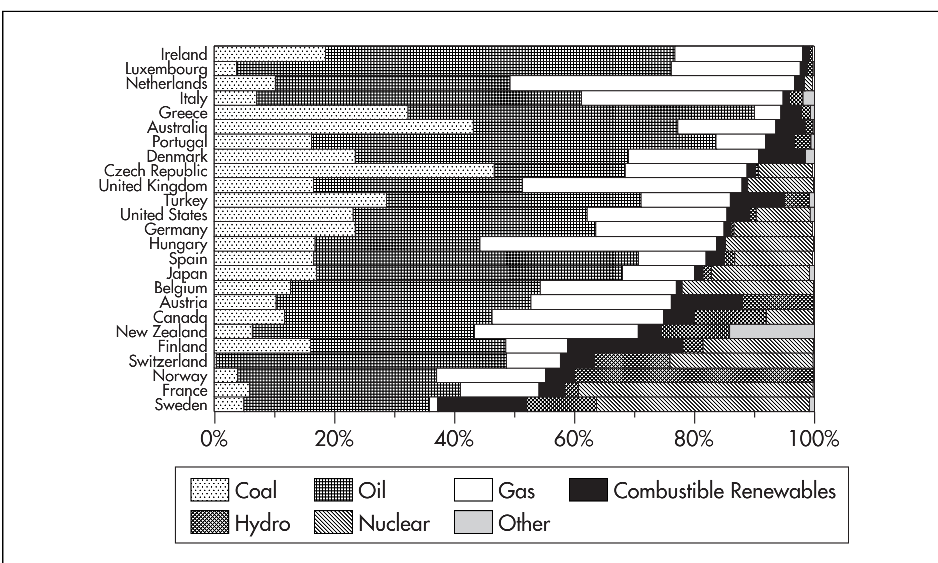
Sources: IEA calculations using IPCC default methodology for CO_2 inventories based on energy balance data (1990; 1998) and energy forecasts from country submissions (2005; 2010).

Figure 28
CO_2 Emissions per Capita by Fuel in IEA Countries, 1998



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and *National Accounts of OECD Countries*, OECD Paris, 2000.

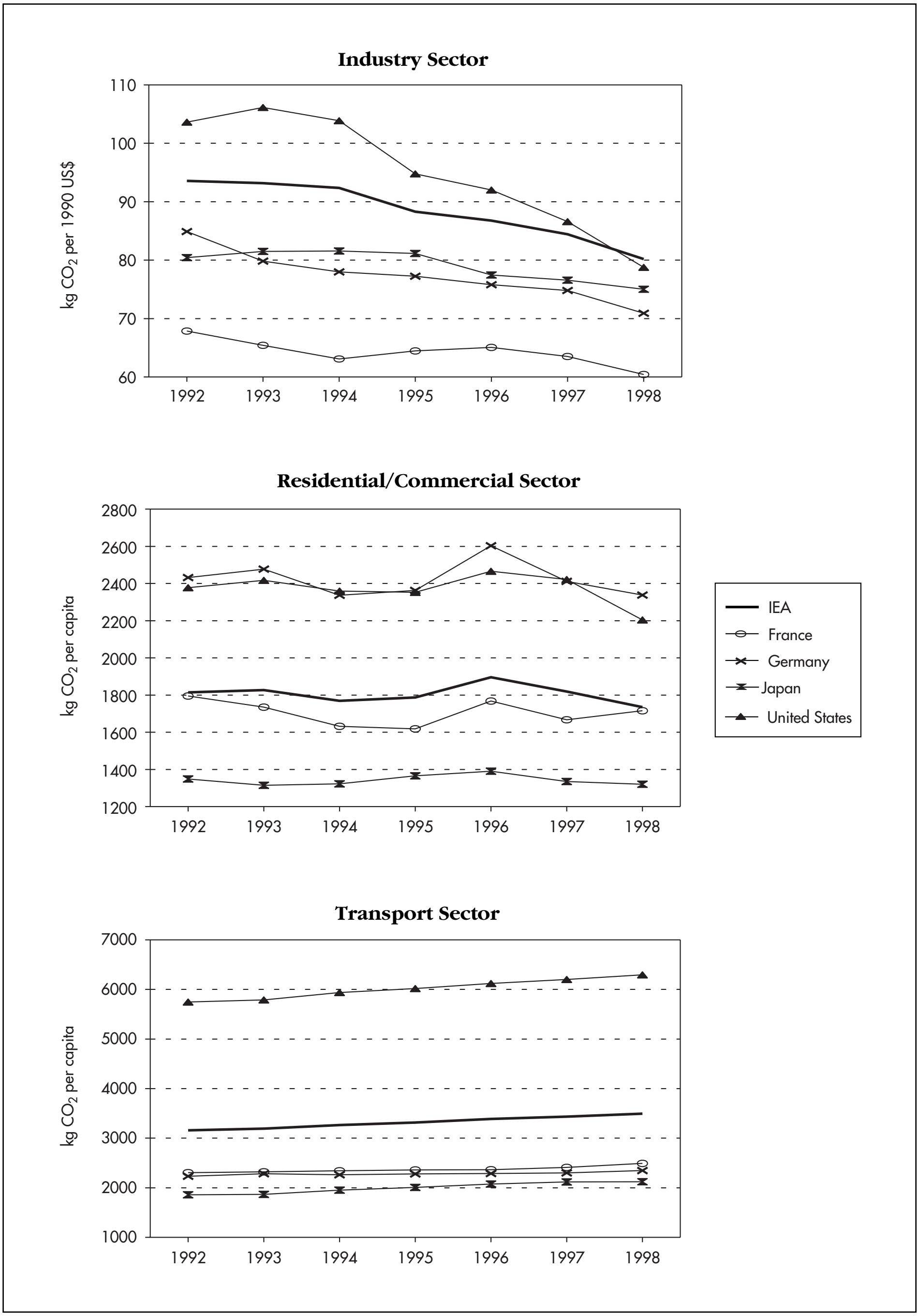
Figure 29
Fuel Share by Country, 1999



Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

Figure 30

Energy-Related CO_2 Emissions by Sector in Selected IEA Countries, 1992-1998



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 and *National Accounts of OECD Countries*, OECD Paris, 2000.

Table 5

Climate Change: Key Energy and CO_2 Emissions Data for OECD Countries, 1998

	TPES (Mtoe)	TPES/capita (toe/person)	TPES/GDP (toe/1990 US$ 1000)	TFC (Mtoe)	Energy-related CO_2 emissions (Mt CO_2)	Energy-related CO_2/capita (t CO_2/person)	Energy-related CO_2/GDP (t CO_2/1990 US$ 1000)	% total OECD energy-related CO_2 emissions	International marine bunkers (Mtoe)	CO_2 emissions from international marine bunkers (Mt CO_2)
Australia	105.01	5.60	0.274	69.14	317.8	16.95	0.830	2.60	0.69	2.20
Austria	28.81	3.57	0.153	24.15	62.5	7.73	0.331	0.51	0.00	0.00
Belgium	58.35	5.72	0.260	41.09	127.1	12.46	0.566	1.04	5.44	17.35
Canada	234.33	7.73	0.351	182.54	480.1	15.84	0.720	3.93	1.14	3.62
Czech Rep.	41.03	3.99	1.552	25.04	121.1	11.77	4.581	0.99	0.00	0.00
Denmark	20.80	3.92	0.126	15.71	59.6	11.24	0.360	0.49	1.40	4.38
Finland	33.46	6.49	0.222	25.02	60.7	11.79	0.403	0.50	0.52	1.64
France	255.67	4.34	0.190	166.86	389.4	6.62	0.289	3.19	2.87	9.14
Germany	344.51	4.20	0.183	243.19	876.1	10.68	0.465	7.17	2.05	6.50
Greece	26.98	2.57	0.279	19.08	85.2	8.11	0.880	0.70	3.50	11.10
Hungary	25.26	2.50	0.715	17.23	58.0	5.74	1.642	0.47	0.00	0.00
Iceland	2.63	9.59	0.351	1.98	2.4	8.92	0.327	0.02	0.06	0.18
Ireland	13.25	3.58	0.163	9.96	39.7	10.72	0.490	0.33	0.16	0.50
Italy	167.93	2.95	0.140	128.89	434.8	7.63	0.363	3.56	2.65	8.38
Japan	510.11	4.03	0.154	336.54	1147.2	9.07	0.347	9.39	5.50	17.61
Korea	163.38	3.52	0.422	109.70	371.7	8.01	0.960	3.04	6.02	19.15
Luxembourg	3.32	7.79	0.210	3.25	8.0	18.89	0.509	0.07	0.00	0.00
Mexico	147.83	1.55	0.442	97.47	364.0	3.80	1.089	2.98	0.80	2.46
Netherlands	74.41	4.74	0.213	57.95	181.1	11.54	0.519	1.48	12.29	39.09
New Zealand	17.16	4.52	0.330	12.25	32.3	8.51	0.620	0.26	0.33	1.05
Norway	25.42	5.75	0.165	20.10	35.9	8.12	0.233	0.29	0.90	2.81
Poland	96.44	2.49	1.234	63.50	320.8	8.30	4.105	2.63	0.77	2.46
Portugal	21.85	2.19	0.261	17.17	55.8	5.59	0.666	0.46	0.38	1.21
Spain	112.78	2.86	0.195	80.51	261.5	6.64	0.452	2.14	6.02	19.15
Sweden	52.47	5.93	0.210	35.33	54.9	6.20	0.220	0.45	1.57	4.98
Switzerland	26.60	3.74	0.112	20.95	45.1	6.35	0.190	0.37	0.01	0.03
Turkey	72.51	1.12	0.347	53.74	189.0	2.92	0.906	1.55	0.16	0.50
United Kingdom	232.88	3.93	0.207	158.97	566.8	9.57	0.505	4.64	3.06	9.62
United States	2 181.80	8.11	0.310	1429.66	5467.2	20.32	0.776	44.76	22.95	72.63
EU (15)	1 447.47	3.87	0.187	1027.12	3263.2	8.72	0.422	26.71	41.91	133.04
IEA (24)	4 645.66	5.11	0.234	3169.26	11035.7	12.14	0.557	90.34	73.59	233.50
OECD (29)	5 096.97	4.63	0.247	3466.96	12215.8	11.10	0.591	100	81.23	257.74

Note: In Table 5 and throughout this book, the term "'energy-related' CO_2 emissions" specifically means CO_2 from the combustion of the fossil fuel components of TPES (i.e., coal and coal products, crude oil and derived products, natural gas and peat), while CO_2 emissions from the remaining components of TPES (i.e., electricity from hydro, other renewables and nuclear) are zero. Emissions from the combustion of biomass-derived fuels are not included in accordance with the IPCC greenhouse gas inventory methodology. TPES, by definition, excludes international marine bunkers. Intergovernmental Negotiating Committee for a Framework Convention on Climate Change-IX decided in Geneva on 18 February 1994 that emissions from international marine and aviation bunkers should not be included in national totals but should be reported separately, as far as possible. The last two columns in the table show quantities of fuels delivered for international **marine** bunkers and the emissions arising from their use. Data for deliveries of fuel to international **aviation** bunkers are not generally available to the IEA.

Sources: IEA, *Energy Balances of OECD Countries* (Paris : OECD 2000). *IEA Databases*.

ENERGY POLICY DEVELOPMENTS IN IEA MEMBER COUNTRIES

ENHANCING COMPETITION

Electricity

Status of Reform in IEA Countries

There is an increasingly clear trend in OECD countries towards a new organisation of the electricity industry aimed at promoting competition for the benefit of consumers. Whereas electricity industries were previously organised as vertically-integrated utilities, the trend is towards a growing number of competing market players. Key elements are that consumers are being allowed to choose their electricity supplier, and there is increasing competition among generators and end-use suppliers. All parties have access to the grid and, in a growing number of cases, wholesale markets are being established.

Virtually all OECD countries have opened up their electricity markets, at least for the big industrial users. Electricity markets are also open to households and small companies in a growing number of OECD countries, including Finland, Germany, New Zealand, Norway, Sweden, England and Wales in the UK, and several states in the US and Australia. Denmark is planning to introduce full consumer choice by 2001, the Netherlands by 2004 and Spain by 2007. By 2007, roughly 500 million consumers (and all large industrial users) in the OECD will be entitled to choose their electricity supplier. This accounts for nearly 50 per cent of the population of OECD countries.

February 1999 marked the deadline for the transposition of the EU Electricity Directive in most EU countries. There was a one-year extension of the deadline for Belgium and Ireland and a two-year extension for Greece. As a result, by February 2000, all EU countries except Greece had implemented legislation to open up at least 30 per cent of their electricity markets. In addition, a number of early European reformers have recently adopted measures to further accelerate the development of effective competition. In the UK, the New Electricity Market Arrangements (NETA) were approved by government in 1999 and implementation was expected in the second half of 2000. NETA will establish a voluntary wholesale power market with more demand-side participation (e.g., through demand-side bidding). The new arrangements are similar to those established in some other European countries, in the United States and in New Zealand. In Finland and Sweden, regulation was reformed to eliminate barriers to choice by small consumers, including the introduction of "load-profiling" [2]. These measures are having a significant impact on the development of

2. With load-profiling, billing to small consumers is based on standardised load profiles instead of on actual consumption. This eliminates the need for small consumers to install meters with time-of-use metering capabilities, which are relatively expensive.

retail competition. In Germany, intense price competition developed during 1999 and 2000 resulting in large price reductions for electricity consumers.

In North America, significant progress has been made in introducing competition in the electricity industry. As of April 2000, 22 US states have approved restructuring legislation introducing third party access to the transmission and distribution networks under state jurisdiction and opening retail markets to competition. In parallel, the Federal Electricity Regulatory Commission (FERC) issued Order 2000 on Regional Transmission Organisation aimed at fostering the development of wholesale competition. In Canada, where reform activity occurs mostly at the provincial level, Alberta and Ontario have firm plans to allow end-users to choose suppliers by end 2000.

The partial opening of the Japanese electricity market was implemented on 21 March 2000, giving a choice of suppliers to the largest energy users, i.e., those using more than 2 MW and taking power at 20,000 volts or above. These users account for some 30% of total electricity demand. Access to the grid is on the basis of negotiated tariffs. Other related measures include a re-examination of electricity tariffs, the introduction of a full-scale bidding system for the development of thermal power, and the simplification of some administrative procedures. The new system will be reviewed three years after implementation.

Market and Industry Trends

In tandem with the introduction of consumer choice, the structure of the electricity industry is also changing. The vertically-integrated utilities of the past are being replaced by companies which specialise in generation, wholesale trading, retailing ("commercialisation") and brokering and which compete with each other to sell their services. However, network activities (i.e. transmission, system operation and distribution) remain regulated and under the control of single companies.

Organised electricity spot markets (i.e., "power exchanges") are being established throughout the OECD. As of May 2000, there were already four in Europe (England and Wales, Nordic countries, Spain and the Netherlands), five in North America (Alberta, California, Pennsylvania-New Jersey-Maryland, New England and New York) and two in the Pacific Basin region (Australia and New Zealand). Power exchanges outside the OECD are presently located in South America but other countries have plans to open exchanges in the near future. Power exchanges are generally voluntary, and bilateral trade outside the exchanges is allowed. The introduction of power exchanges has caused electricity prices to fluctuate, sometimes markedly, reflecting changing supply and demand conditions. To hedge price volatility, electricity futures and other financial contracts are being developed, and the trade in these financial instruments is soaring.

Electricity markets are expanding beyond national and state boundaries. New regional markets are developing in Australia, the European Union (EU) and North America, and electricity companies are quickly adapting to the larger geographical markets. One of the most visible signs of adaptation is the consolidation of the electricity industry. A wave of mergers and acquisitions of electricity companies around the world is increasing the typical size of companies and enlarging the scope of their activity from national to multinational (Table 6). PricewaterhouseCooper estimated that the value of cross-border mergers and acquisitions in the power sector increased from $20 billion in 1996 to $38 billion in 1999[3]. These figures account for only a fraction of total merger activity in the industry as they exclude domestic mergers and acquisitions, e.g. the $17 billion VEBA-Viag merger in Germany, over $30 billion in mergers among several United States utilities[4], and over 40 GW of United States generating plant acquisitions and other domestic activity in Europe and the United States. Competition authorities are increasingly active in the investigation of merger cases. Some of the mergers announced since 1998 were not approved at the time of publication of this book.

The "gas-electric convergence" merger is becoming increasingly common. The buyer is frequently an electric utility, while the acquisition is a natural gas utility. Investment in the natural gas sector by electric utilities is an attempt to exploit synergies such as distributing and retailing of both gas and electricity to customers, the use of gas as an input fuel for both centralised and decentralised power generation, and the wholesale arbitrage opportunities between gas and electricity. From 1997 to 1999, 22 convergence mergers worth $56.6 billion were announced in the US.

Trends in Electricity Regulation

Electricity networks remain regulated in OECD countries. In particular, system operation (i.e. the operation of the transmission system) and distribution services are provided monopolistically. The regulation of the grid monopolies involves two key elements. First, there is an obligation to allow generators and end-user suppliers the use of the electricity network so that they can actually compete. In most systems, there is regulated third party access, i.e., the price for using the network is set by the regulatory authorities. Second, to make third party access effective, all countries have introduced some degree of separation or "unbundling" of the network from generation and retailing activities. Unbundling is intended to eliminate the ability and the incentives of the network monopolies to take advantage of their position. In practice, unbundling takes many forms, ranging from a separation of the accounts of network activities to so-called "divestiture" which occurs when the owners of the grid are not allowed to own a significant stake in other electricity companies. Strong unbundling policies, requiring transmission activities to be managed by separate companies, independent of other industry interests, have been adopted in Australia, Finland, New Zealand, Norway, Spain, Sweden, the UK and a growing number of states in the US.

A key issue in many reforming countries is the transmission of electricity between previously separated markets. In the EU, the rules for transmission access and pricing

3. PricewaterhouseCooper: "Electric Deals: Cross Border Mergers and Acquisition in the Electricity Sector 1999". January 2000.
4. US Energy Information Administration, *The Changing Structure of the Electric Power Industry 1999: Mergers and other Corporate Combinations*, December 1999.

Table 6
Recent Large Electric Utility Mergers and Acquisitions

Companies	*Year agreed*	*Value ($ billion)*	*Comments*
VEBA (Germany) – Viag (Germany)	1999	17	37% of German sales. 14.7 million customers (including indirect sales). Approval Pending.
Unicom (US) – PECO (US)	1999	8.2	5 million customers in combined utility.
Carolina Power and Light (US) – Florida Power (US)	1999	8.0	17.5 GW, 2.5 million customers in combined utilities.
Suez Lyonnaise (France) – Tractebel (Belgium)	1999	7.9	Acquisition of outstanding 49% of Belgian utility group. S-L has 40 GW of power generation assets on 6 continents.
Consolidated Edison (US) – Northeast Utilities (US)	1999	7.8	5 million electricity customers (1.4 million gas).
New Century Energies (US) – Northern States Power (US)	1999	4.9	3 million electricity customers (1.5 million gas).
AES (US) – Drax (UK)	1999	3.0	Purchase of UK's largest coal power station by US IPP.
Electricité de France (France) – Energie Baden-Wuerttemberg (Germany)	1999	2.5	Acquisition of 25% stake in privatisation.
Reliant Energy (US) – UNA (Neth) Suez Lyonnaise (France) – EPON (Neth) VEBA (Germany) – EZH (Neth)	1999	2.4 2.2 0.95	3 of 4 Dutch generators taken over by foreign utilities in privatisations.
Cheung Kong (Hong Kong) – ETSA (Australia)	1999	2.2	Privatisation – rare case of non-OECD acquiring OECD.
Endesa (Spain) – Endesa (Chile)	1999	2.1	Increase in shareholding from 26%-51%.
PowerGen (UK) – Louisville Gas and Electric (US)	2000	5.4	Combined company would have 15 GW of capacity and 3.6 million customers.
RWE (Germany) – VEW (Germany)	2000	4	38% of German sales. 10 million electricity customers in combined utility. Substantial gas and water supplier. Approval pending

Note: Values are from various sources and may not be strictly comparable. Merger values include assumed debt.
Source: USEIA[5], press reports.

within the EU internal market are being discussed within the context of the Florence process, an informal body steered by the EU Commission comprising the regulators and system operators of the EU member countries. Rules are expected to be set during

5. US Energy Information Administration, *Natural Gas 1998: Issues and Trends (1999).*

2000. In the US, the FERC issued Order 2000 in December 1999 requiring utilities owning transmission assets under FERC jurisdiction to develop proposals to establish Regional Transmission Organisations (RTOs). RTOs can be organised in a number of ways, including as transmission companies, that own and operate the transmission grid, or as Independent System Operators, that operate but do not own the transmission grid. Order 2000 is intended to facilitate the development of inter-state trade by unbundling transmission activities and by developing rules and governance structure that discourage discrimination in the provision of transmission services.

Transmission pricing is quickly evolving in the new markets. The use of incentive regulation to promote lower costs and prices in transmission has become common. Incentive regulation is often implemented through a price cap imposed on the average price charged by the transmission companies. Price caps have been introduced in Australia, New Zealand, Norway, Spain and the UK. However, traditional rate of return or "cost of service" regulation of transmission revenues is maintained in several countries including Finland, Sweden and the US.

Pricing of transmission congestion is also evolving. In Europe, most transmission systems are managed on the basis of simple "postage stamp" transmission tariffs, i.e. tariffs that provide access to the whole network regardless of the location at which energy is injected or taken. Postage stamp tariffs do not reflect the scarcity of network capacity. Therefore, whenever transmission constraints emerge, postage stamp tariffs have to be combined with additional mechanisms managed by the system operator to re-dispatch generation when transmission capacity is not available. Alternatively, in the US, Australia and New Zealand, nodal and zonal pricing methods have been developed. These prices reflect the scarcity of transmission capacity thus allowing market players (instead of the system operator) to make their own dispatch and bidding decisions.

Regulatory Institutions

Regulatory institutions are also being reformed in IEA Member countries. In an open market, regulation needs to be "competitively" neutral and independent from industry interests. To adapt institutions to these challenges, new regulatory bodies are being created with different degrees of independence and powers. There are independent regulatory agencies with specific regulatory powers in Australia, Canada, Denmark, Finland, France, Ireland, Italy, Portugal, Sweden, the UK and the US. Independent agencies with an advisory and dispute resolution role have been established in Belgium, Luxembourg and Spain. New bodies are planned in Greece and Denmark. Hungary, the Netherlands and Norway have autonomous ministerial agencies which are largely independent from the line-ministries in their day-to-day activities. Typically, several institutions have regulatory responsibility over the electricity industry, including federal and state ministries, regulatory agencies and competition authorities. Overall, this trend towards a more complex institutional setting is increasing transparency and regulatory predictability.

Despite diversity in regulatory power and the level of independence, many of the emerging regulatory bodies share some key characteristics. Regulatory agencies often cover both gas and electricity, are responsible for the regulation of transmission, apply similar procedures and are governed by a collegial board. In countries with a federal structure, state regulators tend to specialise in the regulation of retail supply and distribution. In addition, the structure of regulatory institutions is generally adapted to the overall regulatory framework. For instance, regulators have relatively strong powers in countries where regulation emphasises the development of competition through strong unbundling policies.

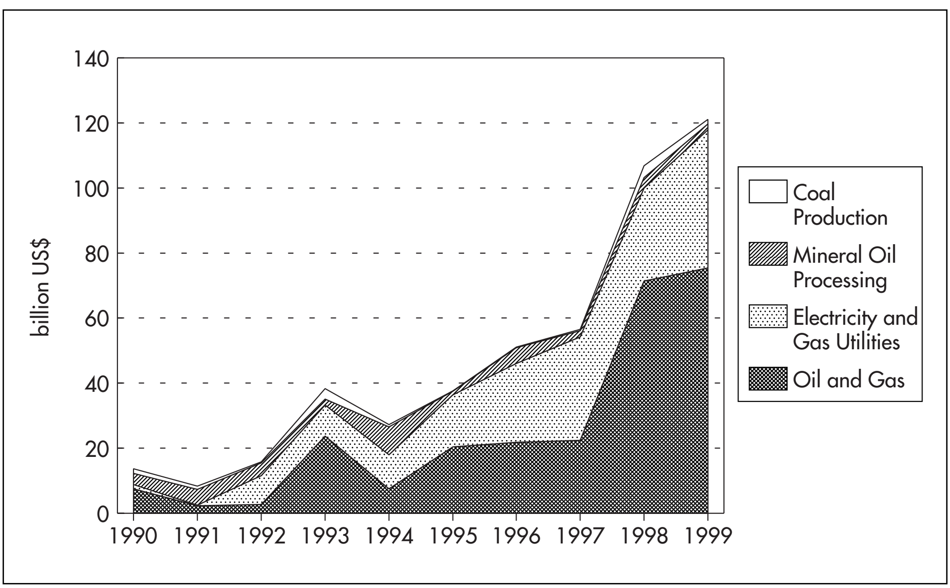
Future Developments

The reform of electricity markets is far from complete but has already delivered some important benefits including reduced costs and prices. In the near future the industry is expected to continue to consolidate through mergers and acquisitions. Competition law will play a role in managing the anti-competitive effects of some of these activities. National (and state) markets will continue their gradual integration into regional markets, aided by the gradual convergence in national regulatory frameworks, and consumers will progressively gain effective access to the retail market.

There is growing awareness of the public service, security and environmental agendas that have to be met in the context of more competitive markets. In the new regulatory frameworks, market players rather than governments direct the outcomes on these issues. A growing challenge for policy-makers is to introduce new policy tools to address environmental, security and public service objectives without distorting competition.

Figure 31

Cross-Border Mergers and Acquisitions in the Energy Sector, 1990-1999



Source: KPMG Corporate Finance.

Gas

Status of Reform in IEA Countries

Virtually all OECD countries are now committed to opening their natural gas supply markets to competition, at least for their large gas users (i.e. power generators, industry and fertilisers). Natural gas markets are also open or opening to households and small consumers in a growing number of OECD countries, including the UK, Germany, Austria, Finland and several states in the US, Canada and Australia. Italy, the Netherlands, Sweden and Spain are planning to introduce full end-user choice between 2002 and 2008.

Liberalised gas markets have yielded clear benefits to consumers in the form of increased choice and lower prices. The price gains from gas liberalisation are generally more modest than from electricity liberalisation, given that the gas industry is generally characterised by inter-fuel competition and by high transport costs. IEA Member countries differ in terms of gas production, import dependency, gas demand, industry structure and market maturity. These factors are central in shaping individual country approaches to gas sector reform.

In OECD Europe, the deadline for complying with the EU Gas Directive was 10 August 2000. The Gas Directive is based on gradually allowing certain consumers to choose their suppliers. It requires that EU member States make final gas consumers that exceed specifically set consumption thresholds eligible for network access and give local distribution companies access for the volumes of gas consumed by the customers in their distribution area that have been designated as eligible. In addition, all power producers are automatically eligible for third party access (thresholds, however, can be set for CHP). The definition of eligibility is governed by threshold levels of gas consumption and by the total percentage share of market opening. For both definitions, the Directive sets precise rules: initially, final customers taking at least 25 million cubic metres per year should become eligible. After five years, this threshold should be reduced to 15 million cubic metres per year, and after ten years to 5 million cubic metres per year. If these thresholds fail to achieve an initial market opening of at least 20%, a market opening of 28% 5 years later, and 33% thereafter, then member States are obliged to lower the thresholds in order to reach these targets. Member States may also apply higher thresholds to avoid exceeding market-opening levels of 30% initially, 38% after five years and 43% after ten years. Table 7 summarises the obligations with respect to eligibility and market opening.

The Gas Directive also ensures freedom to build and operate natural gas facilities via the granting of authorisations or licences on the basis of objective, non-discriminatory and transparent criteria.

The Gas Directive defines two approaches to third party access (TPA): negotiated and regulated. Regulated TPA implies a right of access to the system on the basis of published and fixed tariffs. Under negotiated TPA, the parties are asked to engage into commercial negotiations for access, but gas companies are to publish their “main commercial conditions” for the use of their system. So far, the UK, Ireland,

Table 7
Consumer Eligibility under the EU Gas Directive

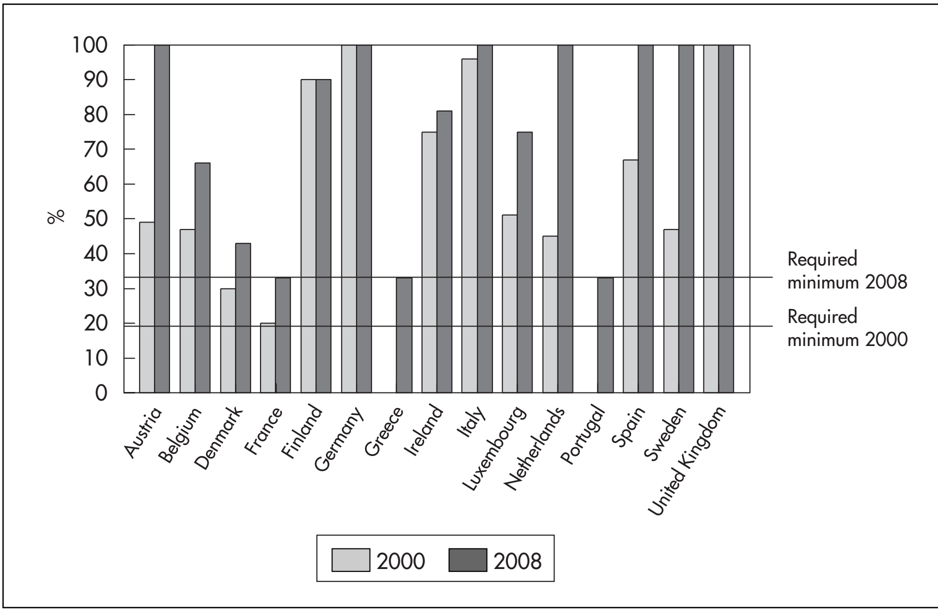
	August 2000	*August 2003*	*August 2008*
Power producers	All	All	All
Final consumers with a minimum consumption of	> 25 million cubic metres per year	> 15 million cubic metres per year	> 5 million cubic metres per year
Minimum market opening	20%	28%	33%
Optional ceiling of market opening	30%	38%	43%

Italy, Finland and Spain have chosen regulated TPA, whereas Germany, Belgium and the Netherlands are favouring the negotiated approach. In Denmark, access to the system at the distribution level will be regulated, while access to the transmission network and storage will be subject to negotiation.

Most EU member States will exceed the Directive's minimum requirements of market opening. In the UK (except Northern Ireland) the market was fully liberalised in 1998. Spain issued a Royal Decree and a Hydrocarbon Law in 1998 providing for market opening, and a decree on access tariffs is pending. In the Netherlands, a new gas law was passed by Parliament in June 2000. In Germany, a new energy industry act is in force since 1998, and gas sector-specific amendments are expected; a detailed agreement regulating conditions for third party access is being finalised between the gas supply and consuming industry federations. In Denmark, an act on market opening in the natural gas supply was passed by the Parliament in May 2000. In Italy, a far-reaching decree on gas market opening was adopted. Belgium adopted a law for gradual opening in 1999. Draft legal texts are being discussed in Austria, Sweden, Denmark and France. The degree of market opening via third party access in EU countries is illustrated in Figure 32.

In North America, the US wholesale market for gas is already highly competitive, with thousands of producers, independent marketers, pipeline affiliates, local distribution companies (LDCs), and end users who compete to buy and sell gas at the wellhead as well as at market centres located across the country. Commodity sales are increasingly short-term in nature, with gas changing hands numerous times between the wellhead and the burnertip. In recent years, the retail natural gas sales market has become more competitive, as various states have initiated individual retail unbundling programmes to introduce more choice to retail consumers. As of June 1999, eleven states have active unbundling programmes or are in the implementation phase, nine states and the District of Columbia have pilot programmes or partial unbundling programmes, eleven states are considering action on unbundling plans, and eighteen states have taken no action. Consumer acceptance of these programmes is mixed. In Nebraska, 97 per cent of eligible residential consumers have elected to choose their own supplier, while in other states participation of eligible consumers is 2 per cent or less.

Figure 32
Planned Gas Market Opening in the European Union



Source: European Commission, DG Trend.

The Japanese gas industry is fragmented into many vertically-integrated regional gas companies, most of which produce or import their own gas, rather than buying from a transmission company as in Europe. Some smaller gas companies purchase gas from the larger ones, and all companies have exclusive supply areas. Electricity utilities are major importers of gas for their own use. The revision of the Gas Utility Industry Law took effect in 1995 and allowed, under certain conditions, large consumers (i.e. consuming 2 million cubic metres per year or more) to circumvent their local/regional supplier and to negotiate prices and conditions of supply with other gas companies, for example an LNG-importing electricity utility. By 1998/99, this had led to some competition and contractual supply improvements for large-scale consumers. The Gas Utility Industry Law was further revised in May 1999 as follows:

- gas utilities no longer have to seek government approval in the case of a reduction in gas tariffs;
- the consumer eligibility threshold for access was reduced to 1 million cubic metres per year; and
- the major gas transmission companies were required to publish their tariff and supply conditions for third party access.

In Australia, the gas industry has developed on a state basis, with little or no interconnection between states to enable gas trade. Competition between gas producers has been limited in the past, with most major gas markets in Australia supplied by a single transmission pipeline connecting the market to a single basin. Each market has usually been supplied by a single retailer and distributor, and the supply basin has also typically been dominated by a single joint venture producer. The industry was therefore characterised by a monopoly structure in the production, transmission, distribution and retail stages of the network.

In the mid-1990s, Commonwealth, state and territory governments agreed to increase competition in the natural gas industry. Regulatory and legislative barriers to inter-state trade in gas were removed, and a uniform framework to govern third party access to natural gas high-pressure pipelines was introduced. Two key features of the access regime are a requirement for pipelines to provide non-discriminatory access to third parties on a fair and reasonable basis and a requirement for contestable gas businesses (e.g. retailing and production) to be separately owned from the monopoly pipeline transmission and distribution businesses. Access tariffs need to be approved by a regulator, but pipelines and access-seekers are able to negotiate other terms and conditions of access. Competition is now being introduced in the retail sector with the progressive lowering of thresholds, which enables gas customers to choose their gas supplier. Large industrial customers in most jurisdictions are currently able to choose their gas supplier, and small business and household customers in the majority of jurisdictions are scheduled to be able to choose their gas supplier by the end of 2001.

Outlook

In all OECD regions, further progress in regulatory reform will continue over the medium term and gas markets will become more competitive, thus price levels should remain relatively moderate despite strong growth in gas demand. Over the long term, the need for developing additional gas supply sources and transport infrastructure will be felt almost everywhere, though at different times and costs, depending on the lifetimes of presently exploited reserves and the proximity, structure, depth and gas quality of new fields. According to each region's or country's specific situation, the cost of new supplies will affect the consumer gas price levels and could slow the overall growth in gas demand.

Coal

Status of Coal Subsidies

The "Shared Goals" of the IEA, while emphasising the importance of the diversity of energy supplies, also underline the importance of undistorted energy prices in enabling markets to work efficiently.

A number of hard coal producing countries give varying measures of financial and other protective assistance to their indigenous producers. As the world's hard coal resources are abundant, geographically widespread, with reserves held by a number of IEA Member countries and with a well-established international trading regime, the IEA does not consider there to be a realistic security of supply justification for such assistance to continue. The IEA considers it important to measure the level of this support in IEA Member countries and to encourage its members to seek an early removal of such assistance (e.g., in the in-depth reviews of energy policies). Where Member countries justify such aid on social and regional grounds, the IEA believes that there are other, more efficient, methods of targeting scarce financial resources to regions affected by the decline of the indigenous hard coal industry.

Coal production subsidies have come under particular scrutiny because of their potential environmental impact. Removal of coal production subsidies would lead to a reduction in greenhouse gas emissions, as long as indigenous production is not replaced by imported coal. Recent analysis by the IEA shows that subsidy reforms in large countries outside OECD would achieve a very substantial decrease in greenhouse gas emissions and improvement in economic efficiency[6].

Since 1987, the IEA has used the Producer Subsidy Equivalent (PSE) methodology, originally applied within the OECD to measure the value of financial support for the domestic production of agricultural products, to estimate the level of financial assistance to indigenous hard coal production in IEA countries. By using this standardised indicator, the IEA has been able to effectively measure the level of state aid and its evolution over time.

In 1999, IEA Member countries produced 1,121 million tonnes of coal equivalent[7] (tce) of hard coal. Of this, 59 million tce, or some 5.3 per cent, located in France, Germany, Japan, Spain and Turkey, received state aid as measured by the PSE.

The breakdown for 1999 of the 59.0 million tce of assisted hard coal production is as follows:

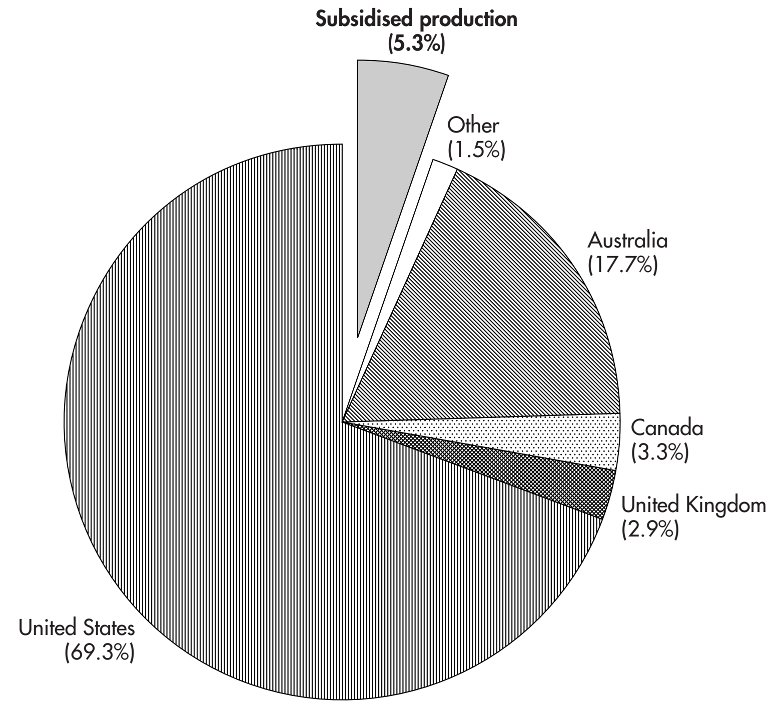
Table 8

Subsidised Hard Coal Production in the IEA, 1999

	Million tce	*Percent*
France	4.1	0.4
Germany	40.1	3.6
Japan	3.0	0.3
Spain	10.3	1 0
Turkey	1.5	0.1
Total	**59.0**	**5.3**

6. The study *World Energy Outlook 1999 Insights: Looking at Energy Subsidies – Getting the Prices Right* looked at subsidies for energy consumption in eight non-member countries. The reduction of these subsidies would yield energy savings of 13 per cent and a reduction of carbon dioxide emissions of 16 per cent in these eight countries, corresponding to global reductions of 3.5 per cent in energy use and 4.6 per cent in greenhouse gas emissions.
7. Tonne of coal equivalent (tce) is a standard unit of measurement in the international coal industry, having an energy value of 29.3 GJ/tonne or 7,000 kcal/kg. One tonne of coal equivalent is equal to 0.7 tonne of oil equivalent. The actual relation between physical tonnages and tce differs for each producing country, and averages for each year are published in *IEA Coal Information*.

Figure 33
IEA Hard Coal Production, 1999



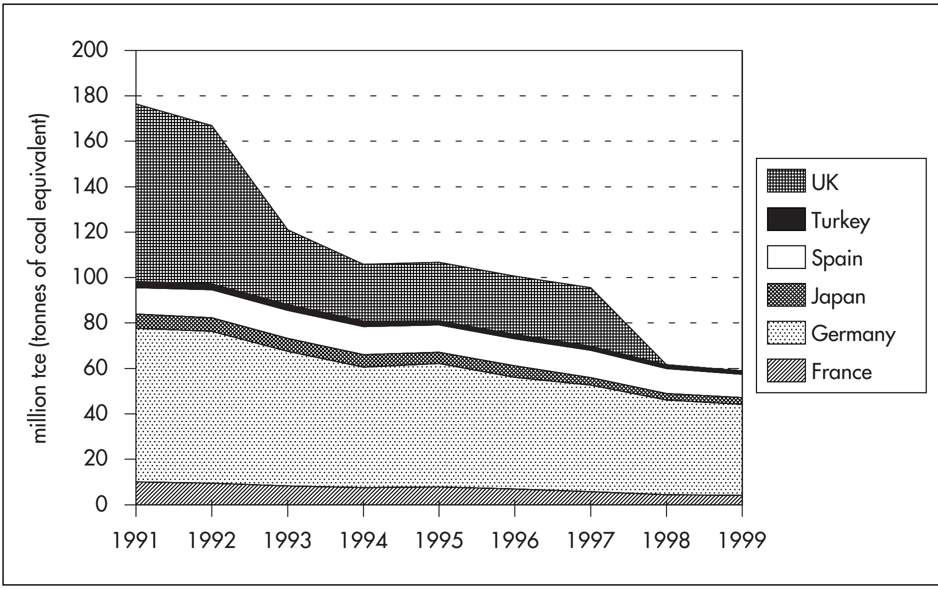
Source: *Coal Information 1999*, OECD/IEA Paris, 2000.

The amount of IEA hard coal production receiving government financial assistance, as measured by the PSE, has declined over the past decade, both in absolute and in percentage terms. Subsidised production in the IEA fell 66 per cent from 1991 to 1999 (Figure 34), largely because of programmed decreases in domestic production and the complete elimination of subsidies in the UK. In 1999, assisted production declined by only 3.4 per cent from its 1998 level.

Total PSE assistance has declined more slowly than total production, i.e. by nearly 50 per cent in nominal terms from its 1991 level of $6.15 billion in 1999. Thus, average PSE per tce increased in the early 1990s, and hovered about $100/tce from 1994 to 1999.

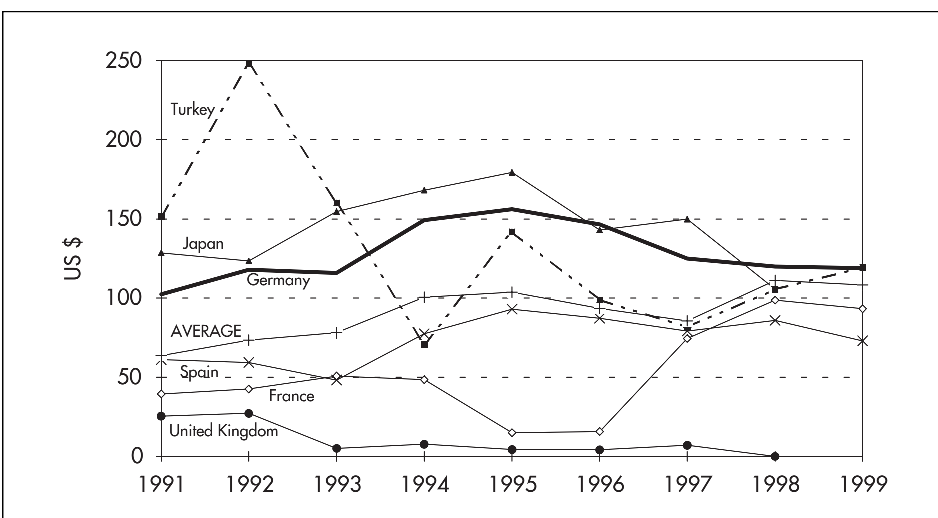
The elimination of subsidised production in the UK, Belgium and Portugal implies that the remaining subsidised production is concentrated in fewer countries. Germany now accounts for two-thirds of the subsidised production and for 75 per cent of the PSE assistance. Spain accounts for 17 per cent of production and 11 per cent of the PSE.

Figure 34
Assisted Hard Coal Production in IEA Countries*, 1991-1999



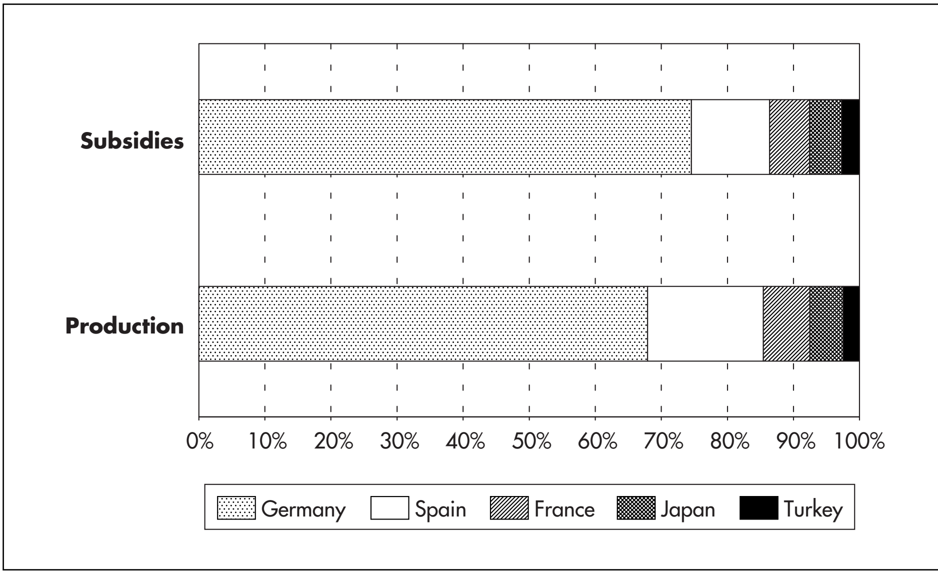
* Assisted sub-bituminous production in Spain is included. Belgium (production halted in 1992) and Portugal (production halted in 1994) have not been included.
Source: *Coal Information 1999*, OECD/IEA Paris, 2000.

Figure 35
Aid per Tonne of Coal Equivalent, 1991-1999
(US$)



Source: *Coal Information 1999*, OECD/IEA Paris, 2000.

Figure 36
Shares of Subsidies Paid and Subsidised Production



Source: *Coal Information 1999*, OECD/IEA Paris, 2000.

Outlook

Germany is expected to reduce subsidised output by one-third and to reduce PSEs by a similar amount by 2005. Spain is expected to reduce production by 20 per cent by 2005. France is projected to close its coal industry by 2005, and Japan expects to eliminate subsidies by 2006.

Despite this trend to reduce subsidies, the total elimination of coal production subsidies in IEA countries is not expected in the foreseeable future. New mechanisms have been developed to provide support to the coal industry largely aimed at ensuring security of supply. For example, both Spain and France have transposed Article 8.4 of the EU Electricity Directive into their national electricity legislation, which permits Member states to give priority of up to 15 per cent of primary energy used in electricity production to indigenous fuels. Spain has introduced a further transitory provision to pay utility companies a premium to use domestic coal. The United Kingdom also had a suppression of consent for the development of gas-fired power generation (coal's chief competitor) and on lifting this suppression, announced that it was seeking ways to subsidise the coal industry directly. In Germany, access to the power network could be refused until 2003 to competitors who might displace the demand for electricity generation from lignite produced in the former East German Länder.

Nevertheless, a number of factors will support this trend to reduce subsidised production and to eventually eliminate subsidised coal production. Electricity market liberalisation will make electric utilities increasingly reluctant to take on obligations to purchase domestic coal when it is not competitive with either imported coal or with power generation by competing fuels. In the European Union, expiry of the Coal and Steel Community Treaty in 2002 will force EU states to review the case for continued subsidies of the coal industry. Finally, environmental factors and, in particular, the imposition of targets to reduce greenhouse gas emissions under the Kyoto Protocol, will be increasingly important drivers to reduce energy subsidies.

POLICIES AND MEASURES TO MITIGATE CLIMATE CHANGE IN IEA MEMBER COUNTRIES

Responding to climate change mitigation will require governments to implement policies and measures to change the ways in which societies produce and consume goods and services. In 1992, in the United Nations Framework Convention on Climate Change (UNFCCC), the need to undertake such policies was explicitly agreed. The Convention requires all Parties to:

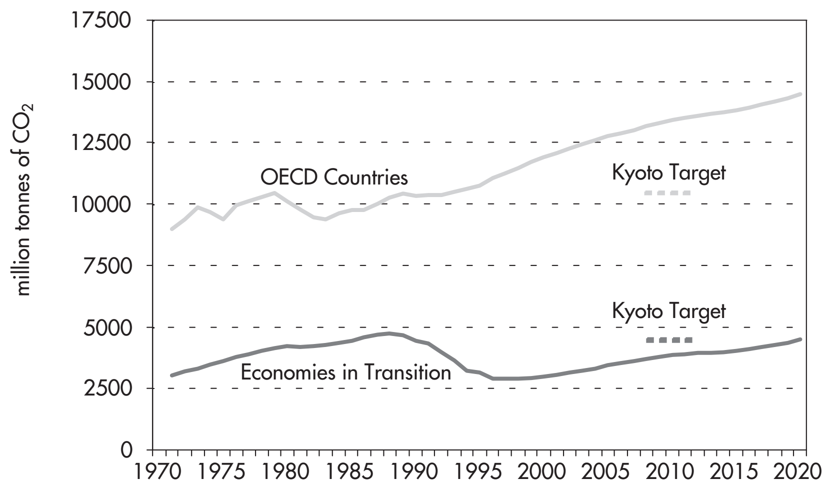
"Formulate, implement, publish and periodically update national and, where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change."[8]

Policies and measures were to be taken, *inter alia*, with the intent of providing Parties with the means of returning their emissions to 1990 levels by the year 2000. Despite some progress in the design and implementation of policies to limit GHG emissions, nearly all OECD countries are anticipated to significantly exceed the voluntary aim of the Convention (Figure 37 and Table 9), although it has also been suggested that the failure to meet the FCCC aim reflects time needed to design and implement effective mitigation policies. Nevertheless, the policies enacted have no doubt resulted in emissions that are lower than those that would have occurred without any action.

In 1995, Parties to the UNFCCC acknowledged that the emissions reduction targets of the Convention would likely be exceeded, and negotiated and adopted the Kyoto Protocol. The Protocol set legally binding targets for GHG emissions reductions in the 2008-2012 time frame for all OECD countries, as well as for the economies in transition. For most countries, the commitment entailed a reduction below 1990 levels (for a small minority, the obligation is to limit growth to a small increase over 1990 levels and for others, the base year may be altered). In addition, countries are allowed to "bubble" their emissions, and as long as the total is kept within the agreed amount, individual national allocations can be altered. The European Union chose to reallocate in this manner.

8. UNFCCC Article 4.1(b).

Figure 37
Energy-Related GHG Emissions of Annex I Countries, 1990–2020 (projected)



Source: *World Energy Outlook*, 1998, IEA/OECD Paris.

The Protocol includes not only CO_2, but methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). The commitments include both the sources of CO_2 and sinks. Given the predominance of energy-related CO_2 emissions, a significant share of current national policies and the majority of mitigation analyses focus on CO_2 reduction. A number of key factors affect the overall growth in energy-related emissions, including population, GDP, primary energy supply, and carbon intensity.

Both energy intensity and carbon intensity are currently declining in IEA countries, and they are projected to continue to decline. However, in order to reduce total emissions, further reductions in energy-related emissions are needed to offset the very substantial growth in other key factors of the economy that contribute to emissions growth.

Aggregate intensity figures mask considerable differences among IEA countries. For example, Norway and Switzerland produce no emissions from electricity generation as their entire production is either from hydro-electricity or nuclear power. Other countries have only a tiny share of emissions from the residential and commercial sector (a sector in which most of the emissions are from heating and cooling, and thus are highly dependent on climatic differences among countries).

Applying a successful policy in one country to another needs to take into account these critical variations between countries. Table 10 provides an indication of the extent of such variations within the OECD Member countries.

Table 9

Annex B Targets in the Kyoto Protocol (Note: EU Country Targets are Listed According to the "Burdensharing Agreement")

Party	*1990 GHG emissions (tonne CO_2 equiv)*	*% change 1990 - 96*	*Kyoto Target (% change from 1990)*
Australia	411	8.2	8.0
Austria	74	2.6	-13.0
Belgium+++	139	9.3	-7.5
Bulgaria	123	-31.6	-8.0
Canada	591	11.2	-6.0
Croatia	..	..	-5.0
Czech Republic	190	-20.1	-8.0
Denmark	72	29.3	-21.0
Estonia	41	-43.3	-8.0
European Community			-8.0
Finland	72	7.3	0.0
France	554	1.1	0.0
Germany	1 201	-11.5	-21.0
Greece	104	6.6	25.0
Hungary* +	87	-8.7	-6.0
Iceland+	3	4.7	10.0
Ireland	57	5.0	13.0
Italy+	533	1.7	-6.5
Japan	1 175	9.4	-6.0
Latvia	36	-49.4	-8.0
Liechtenstein	260	..	-8.0
Lithuania	52	-56.6	-8.0
Luxembourg+	13	-24.0	-28.0
Monaco	111	30.6	-8.0
Netherlands	208	11.4	-6.0
New Zealand	72	3.1	0.0
Norway	47	13.2	1.0
Poland**	459	-5.0	-6.0
Portugal++	68	6.0	27.0
Romania++	229	-28.5	-8.0
Russian Federation++	2 999	-29.6	0.0
Slovakia	72	24.0	-8.0
Slovenia	19	..	-8.0
Spain	301	7.9	15.0
Sweden	69	10.6	4.0
Switzerland	54	-0.6	-8.0
Ukraine	919	-45.7	0.0
United Kingdom	727	-6.0	-12.5
United States	5 903	9.0	-7.0

* Hungary's base year is an average of 1985-88.

** Poland's base year is 1988.

+ 1995 data

++ 1994 data.

+++ 1997 data.

Source: UNFCCC Official Data.

Table 10
Variations in Key Indicators across OECD Countries

Indicator	*Variability factor**
Primary energy/GDP	2.5
CO_2/GDP	2.5
Heating degree days	5
Distance driven/capita	3.5
Freight tons hauled	2
Home size	2
Road fuel prices	3

* The variability factor is an expression of the multiple between the highest and lowest value in the OECD (i.e. for CO_2/GDP, the maximum CO_2 intensity is two and a half times the minimum).

The IEA collected data on policies and measures undertaken by Member countries in energy and energy-related sectors in 1999 (represented in Tables 11 and 12). There is a relatively even distribution within the policy categories, and the majority of countries that have taken any policies (or for which records of policy actions exist) have taken action in multiple sectors.

There is no consistent match between the share of emissions in a given sector and the policy emphasis which is suggested in the 1999 database. However, the database does not account for policies undertaken prior to 1999 – during which time significant actions could already have altered emissions trends. Thus, only a limited set of conclusions may be drawn from this database, as the value of these measures will very much depend upon what has already been undertaken.

Nevertheless, in considering the policies taken, some interesting results emerge. For example, approximately 60 per cent of Norway's energy-related emissions are in the transport sector, and unsurprisingly, nearly a quarter of the policies also focus on this sector. The focus is clearly on seeking to induce a behavioural change, as Norway, which is not an automobile manufacturer, cannot control a technological shift due to its small market share. Given the costs of mitigation in the transport sector, Norway has still chosen to apply a much larger share of its policies to other sectors. Several countries in which transport also accounts for a large share of national emissions have taken a smaller share of their policies in this sector (e.g., Finland, Ireland and Italy). This may be due in part to the fact that pre-existing policies such as high fuel taxes, high road fees and taxes on vehicle purchases already exist, and thus policymakers may consider this sector to be prohibitively expensive compared with other possible policy choices.

Policy actions may be categorised into several distinct groups. In this analysis, the following groupings are used:

- Fiscal policies and market mechanisms – including taxes, subsidies (and subsidy removal), and cap-and-trade programmes;

- Regulatory policies – including regulations, standards, directives and executive orders;

- R&D policies; and

- Processes – where countries are developing outreach programmes or consultative processes to develop, review or implement proposed policy choices.

Relatively low-cost and administratively simple measures make up the bulk of policy actions to date and most of these measures aim to achieve multiple policy objectives. Countries have often undertaken climate-related policies for reasons entirely independent of climate change, and some of these policies may be substantially more influential than those adopted solely for the purpose of moderating GHG emissions. Ancillary benefits such as improved energy efficiency, restructuring/ liberalisation of energy markets, improved local or regional air quality, reduced traffic congestion, waste management and minimisation and methane recovery, the capture and/or elimination of fugitive fuels and environmentally sustainable forestry practices are all significant policy drivers. Ultimately, if climate mitigation is not, itself, a high political priority, these other drivers may lead to the majority of the changes in emissions.

It is difficult to evaluate the effectiveness of climate change policies, since most have only been implemented within the past few years. Although policies chosen and sectors targeted differ widely among countries, some similar tendencies across national mitigation strategies emerge. Policies that affect greenhouse gas emissions include market reform and subsidy reform, particularly in the agriculture and energy sectors. In addition, governments are using a variety of approaches to overcome market barriers to energy efficiency improvements and other "win-win" actions that make economic sense without considering the effects on climate change[9].

The large majority of measures in most countries target CO_2 emissions from the energy sector. However, nearly all countries have some policies to reduce emissions from waste, industrial processes, agriculture and forestry/sink enhancement. Furthermore, the Kyoto Protocol and the Convention provide the flexibility to mitigate greenhouse gas emissions across the range of gases and sectors, which should lower the overall cost of mitigation. Some low-cost opportunities to mitigate greenhouse gases exist in forestry, agriculture and waste sectors.

In addition, the Protocol provides the opportunity for Parties to offset domestic emissions through the Kyoto mechanisms, i.e. emissions trading, joint implementation and the Clean Development Mechanism. Economic analyses indicate that these market mechanisms could provide low-cost alternatives to domestic action, yet, until the rules for the operation of these mechanisms are agreed, it is unlikely that many

9. These opportunities are often referred to as "win-win" or "no-regrets" options. The Intergovernmental Panel on Climate Change (IPCC) estimates that they could achieve gains of 10-30 per cent in energy efficiency over the next two to three decades, at little or no cost in many parts of the world.

projects or trades will be made (although as the IEA data show, a number of countries are already developing these instruments domestically).

The overall stringency of the policies taken is also open to question. Recent economic analyses have suggested that the marginal abatement costs for reducing emissions within OECD countries (were they to undertake all actions domestically) would range between approximately $50 and over $ 1,000 per tonne of carbon[10]. However, even while recognising that the policy package to meet the Kyoto target has not been completely implemented in any country, costs imposed by policies do not yet apparently come close to this figure. Thus, for example, current levels of effort by countries instituting domestic emissions trading (e.g., Denmark) set non-compliance penalties at only $5 per tonne, while others with tax policies provide numerous exemptions and costs are only slightly higher. If the economic models accurately project costs, it thus seems unlikely that the existing effort will be adequate to meet the Kyoto objectives.

The following sections describe some of the actions undertaken by OECD countries in 1999 under the policy groupings used for the IEA database.

Fiscal Policies and Market Mechanisms – Including Taxes, Subsidies (and Subsidy Removals), and Cap-and Trade Programmes

Nearly all OECD countries have adopted some form of fiscal policy in their effort to mitigate climate change (see Table 12). From a purely economic standpoint, fiscal policies are considered to be among the most economically efficient of all government actions. Numerous OECD studies suggest that subsidy removal would have rapid and beneficial effects – not only with respect to GHG reductions, but also in ancillary benefits to national economies. Similarly, tax policies, as well as emissions trading policies, allow markets to efficiently allocate resources to reduce emissions at lowest cost.

Political constraints apply to many fiscal policies as well: for example, subsidies are provided to support certain social values and sectors of economies, and their removal can lead to social disruption. Similarly, economically sound fiscal policies such as taxes are also affected by political constraints. Concern about loss of competitiveness in vulnerable industries leads countries to provide exemptions to taxes, and to apply levels of taxation that are often substantially below the levels required to generate significant emissions reductions. Broadly speaking, however, fiscal policies have the advantage of relative ease in implementation. All governments have mechanisms for tax collection in place – at both upstream and

10. OECD, 1999 "Action Against Climate Change." While marginal costs are high, the OECD concludes that average costs are much lower (e.g. less than 0.5 per cent of GDP in 2010). Most models do not fully account for distributional costs, which may be significant.

downstream points. Thus, where taxes or subsidy removal is the policy choice, relatively low costs and additional administrative burdens are incurred.

In addition to policies that remove distortionary subsidies, it is possible through the addition of financial benefits to provide certain kinds of incentives to new or modified behaviours. Depending on the mechanism for implementation, such policies can provide a direct price signal to the market – and become economically efficient forms of promoting programmes which face other barriers to penetration. Such subsidies can be effective if used over a transitional, relatively short-term period to help establish niche markets for new, clean technologies. However, they may be economically inefficient instruments and lead to environmentally harmful outcomes if they persist, producing perverse incentives that might limit other types of environmental innovation in favour of the subsidised alternative.

While a number of OECD countries subsidise various forms of energy use (e.g. most notable in the coal industry, where over 5 per cent of the coal produced in the IEA Member countries is subsidised), these subsidies have been declining. Since 1992, Belgium, Portugal and the UK eliminated coal subsidies. However, in the database of IEA Member countries' energy policy actions for climate change, no countries have indicated a reduction in any energy subsidies as one of their 1999 policy actions. Conversely, eight countries have taken or propose to add subsidies in sectors ranging from transport (e.g. Japanese subsidies for clean energy vehicles), to power generation (e.g. the Irish subsidies for small-scale renewables projects) to residential/commercial (e.g., the Australian subsidies for a share of the capital value of community use buildings for installing photovoltaic systems).

Taxes are also used by a number of countries in an attempt to mitigate the effects of climate change. In the IEA database, fifteen of the 21 countries reporting are undertaking or planning tax policy changes that will influence GHG emissions. As with subsidies, these changes affect all sectors. Of the nearly 50 tax policies proposed or enacted, one-third relate to transport. Those that are broadly-based energy or carbon taxes, and those that address power generation, each account for another dozen separate initiatives. However, more than half of the total taxation policies listed have yet to be enacted – reflecting in part the political difficulty of undertaking such measures.

A relative newcomer to the list of market-oriented policies, emissions trading, has been adopted by only four countries – including those that have funded project-specific activities with other countries. However, an additional nine countries and the European Community are currently discussing the possibility of adoption of emissions trading policies, and some international institutions are also engaged in trading (e.g., the World Bank with its Carbon Fund). Theoretical analyses suggest that this approach, like taxes, is an economically sound method for cost-effectively reducing emissions. Depending on the stringency with which domestic compliance regimes are established, such policies also deliver environmental results. However, few countries have yet grappled with the difficult task of allocating emissions quotas within sectors – and the political feasibility of implementation is still an open question. In addition, questions regarding the administrative complexity of such policies are also unanswered. The fact that so many countries are exploring the possibilities of a domestic trading regime, does, however, suggest a degree of political enthusiasm for this approach.

Regulatory and Voluntary Policies – Including Regulations, Standards, Directives and Executive Orders

While economic analysis suggests that fiscal policies may be the most economically efficient, such analyses often assume perfect market conditions and an ubiquitous "rational actor". However, such circumstances do not always hold: market failures and barriers clearly exist, and often render other policy approaches useful; in some cases, mandates and regulations may prove more successful policy options. In addition, they have the advantage of often being politically more acceptable and of being within the authority of the government agency seeking the policy result. For example, while finance ministries must be involved in taxation policy, environment ministries (most of which are responsible for both the climate negotiations and implementation of the agreements) and energy ministries often have independent regulatory authority. These factors may help explain why the list of regulatory measures in countries is even lengthier than the roster of fiscal policies. Of the more than 350 reported climate policies in the energy sector planned or implemented by the IEA Member countries over the past year, approximately one-third are regulatory in nature.

While fiscal policies have substantial commonality across countries, regulatory approaches seem much more country-specific. Thus, even when a similar measure is applied in multiple countries, the details are different. For example, 12 IEA Member countries report applying or considering the application of standards and mandates. However, further disaggregation of such regulatory approaches reveals that the only specific policy common to more than one country is a requirement that a minimum share of the total delivered energy be generated by renewable sources (with six countries undertaking this policy). Even here, the level and the timing at which the standard is imposed vary.

Another common approach in this area is the voluntary agreement. Ten countries and the European Union report using this approach to reduce emissions. In the energy sector, most agreements tend to be with electric utilities and industrial consumers. However, some unusual and innovative programmes are also being developed (e.g. the Japanese "top-runner" programme which calls for voluntary standards to be set at the level of the best technology in any given category) which apply more broadly to all sectors.

It is difficult to extrapolate too far based on the current IEA database: many countries adopted policies prior to 1999 (the initial year for data collection), and others indicate that additional policies are currently being planned. However, equally clear is that national circumstances, including domestic economic structure and political constraints, drive differences in policy choices.

Nonetheless, countries have clear experience with the environmental effectiveness and the political feasibility of the regulatory approach. Thus, environmental benefits will likely continue from the labelling, standard setting, and regulatory reforms now being adopted. Regulatory policies, because of their effectiveness and the familiarity with the administrative processes, will also likely continue to be used in the future.

R&D Policies

New, low-emitting GHG technologies can reduce emissions while providing the services needed to sustain high economic growth. Recognising that many promising technologies are not likely to be developed by the private sector due to high front-end investment costs with low short-term profit benefits, governments have traditionally played a strong supporting role in R&D. Within the narrow constraints of the objective of effectiveness in meeting the Kyoto targets at least cost, many of the R&D policies are not likely to be "effective"; few are likely to lead to significant emissions reductions before 2010. Recent analyses (e.g., Clas-Otto Wene, 1999) indicate that the costs of electricity generated through renewables is a function of the cumulative installed capacity. Thus, while prices are falling, renewables technology is not expected to penetrate rapidly enough to have a near-term price decline. However, the long-term nature of the climate change problem has clearly prompted many governments to act now, as is reflected in the large number of R&D policies being taken, and the fact that nearly all IEA Member countries are active in this area.

Governments have chosen several mechanisms to promote technology development, including direct funding for research or demonstration projects, incentives for increasing demand for new technology (e.g., projects which provide financing for consumers of advanced technologies), and incentives for upgrades into new technologies that help reduce corporate risk.

If the technology R&D approach is supported over the long term, significant advances are likely to be made in the area of technology development, perhaps helping to break the link between energy demand and carbon. Of course, there remains the question as to whether choosing to publicly subsidise such R&D is a cost-effective solution to forcing technological change, and whether such changes might have happened even in the absence of such policy choices if the proper economic signals were put in place. Few analyses have been able to isolate and evaluate the extent of the impact of government R&D support in speeding the development or deployment of new technologies. Ultimately, while it is clear that existing technologies as currently deployed are inadequate to meet long-term climate objectives, "best practices" in promoting alternatives are difficult to establish.

Processes – where Counties are Developing Outreach Programmes or Consultative Processes to Develop, Review or Implement Proposed Policy Choices

The political difficulties inherent in adopting policies that force changes on individual and corporate behaviour represent one of the most critical barriers to the adoption of new approaches. Thus, governments have nearly all turned to various forms of consultations at the national and regional level to build consensus around specific options. As with the policies themselves, such approaches differ depending on national circumstances. Canada has instituted a series of public information and consultation programmes; Australia has promoted surveys to evaluate consumer preference as well as holding public consultations; Belgium has called for the formation of panels of experts to evaluate possible new policy choices and report back to the government; Ireland has established a new national institution to promote a broad dialogue on sustainable development; in the US, *inter alia*, a number of academic institutions have held meetings on the science of climate change in an effort to promote action and awareness.

Inasmuch as the results of such consultations produce effective and efficient policies, they can be considered best practice if they help overcome the political barrier. Their effectiveness is hard to judge *a priori,* and even subsequent to the adoption of a policy, it is unlikely to be clear how far the consultation was responsible for the success of the implementation programme.

Table 11

Tabulation of Energy-Related Policies and Measures in the IEA Database

Data from 1999 policies

Country	*Fiscal*	*Regulatory*	*R&D*	*Policy Processes*	*Total*		
					Implemented	*Planned*	*Total*
Australia	1 *(6)*	3 *(4)*	2 *(3)*	10 *(1)*	**16**	***(14)***	**30**
Austria							
Belgium	1 *(4)*	*(4)*		3 *(1)*	**4**	***(9)***	**13**
Canada	5 *(1)*	3	8 *(1)*	9 *(2)*	**25**	***(4)***	**29**
Czech Rep.	*(2)*	*(3)*				***(5)***	**5**
Denmark	4 *(2)*	2	1		**7**	***(2)***	**9**
Finland	2	*(2)*	3	2	**7**	***(2)***	**9**
France	6 *(8)*	10 *(6)*	8 *(1)*	6	**30**	***(15)***	**45**
Germany	1 *(3)*	2 *(1)*			**3**	***(4)***	**7**
Greece		1	1		**2**		**2**
Hungary							
Ireland	1 *(1)*	1	1	1	**4**	***(1)***	**5**
Italy	1	2 *(2)*		1	**4**	***(2)***	**6**
Japan	5 *(3)*	6 *(2)*	5 *(1)*	4 *(1)*	**20**	***(7)***	**27**
Luxembourg							
Netherlands	7 *(6)*	7 *(6)*	1 *(2)*	2 *(1)*	**17**	***(15)***	**32**
New Zealand	*(1)*				**0**	***(1)***	**1**
Norway	6 *(2)*	1	3 *(2)*		**10**	***(4)***	**14**
Portugal							
Spain	1	1 *(1)*	1 *(1)*	1	**4**	***(2)***	**6**
Sweden	2 *(1)*				**2**	***(2)***	**4**
Switzerland	1 *(4)*	2	3	*(4)*	7		
Turkey							
UK	1 *(5)*	*(2)*	1		**2**	***(7)***	**9**
US	2 *(2)*	1 *(11)*	12 *(6)*	4 *(3)*	**19**	***(22)***	**41**
EU	*(3)*	5 *(12)*	1	1 *(2)*	**7**	***(17)***	**24**
Total	**47 *(54)***	**47 *(56)***	**48 *(18)***	**44 *(12)***	**186**	***(139)***	**325**

Note: totals in Tables 11 and 12 are not identical as many policies affect multiple sectors, and are listed as a separate policy in each sector on which the reporting country anticipates an emissions impact.

Table 12

Tabulation of Energy-Related Policies and Measures in the IEA Database, by Sector

Country	*Residential*	*Community-Use*	*Buildings*	*Travel*	*Freight*	*Manufacturing*	*Other Industry*	*Electricity*	*Technology*	*Total*		
										Implemented	*Planned*	*Total*
Australia	6 *(3)*	5 *(2)*	5 *(2)*	7 *(7)*	5 *(5)*	5 *(1)*	5 *(1)*	8 *(6)*	4 *(1)*	**50**	***(28)***	**78**
Austria												
Belgium	*(2)*	*(2)*	*(2)*	1 *(2)*	1 *(2)*	*(2)*	*(2)*	1 *(2)*	*(2)*	**3**	***(18)***	**21**
Canada	8 *(2)*	7 *(2)*	7 *(2)*	11 *(2)*	7 *(2)*	8 *(3)*	8 *(7)*	10 *(2)*	10	**76**	***(22)***	**98**
Czech Rep	*(2)*	*(2)*	*(2)*	*(3)*	*(2)*	*(2)*	*(2)*	*(3)*	*(2)*	**0**	***(20)***	**20**
Denmark	1	1	1	1 *(1)*	1	2	2	4 *(1)*	2	**15**	***(2)***	**17**
Finland	*(1)*	*(1)*	*(1)*	*(1)*	*(1)*	*(1)*	*(1)*	3 *(2)*	*(1)*	**3**	***(10)***	**13**
France	11 *(5)*	3 *(2)*	7 *(4)*	3 *(1)*	2 *(1)*	4 *(6)*	4 *(3)*	8 *(3)*	1 *(1)*	**43**	***(31)***	**74**
Germany	1	1	1	1 *(2)*	1	3	2	2 *(1)*	1	**13**	***(3)***	**16**
Greece	1	1	1	1	1	1	1	1	1	**9**		**9**
Hungary												
Ireland	1 *(1)*	1 *(1)*	*(1)*	*(1)*	*(1)*	*(1)*	*(1)*	2 *(1)*	*(1)*	**4**	***(9)***	**13**
Italy	*(1)*	2	2	1 *(1)*	5	*(2)*	7					
Japan	6	2	3	7 *(3)*	3	4	2 *(1)*	4 *(3)*	4	**35**	***(7)***	**42**
Luxembourg												
Netherlands	8 *(6)*	6 *(4)*	6 *(4)*	8 *(4)*	7 *(5)*	7 *(4)*	8 *(4)*	7 *(12)*	6 *(4)*	**63**	***(47)***	**110**
New Zealand												
Norway	3 *(1)*	3 *(1)*	3 *(1)*	5 *(1)*	4 *(1)*	3 *(1)*	3 *(1)*	3 *(3)*	3 *(1)*	**30**	***(11)***	**41**
Portugal												
Spain	2	2	2	2 *(1)*	2	2	2	3	3 *(1)*	**20**	***(2)***	**22**
Sweden	1	1 *(1)*	*(1)*	*(1)*	2	*(3)*	5					
Switzerland	3 *(1)*	3 *(1)*	3 *(1)*	3 *(3)*	3 *(3)*	3 *(1)*	3 *(1)*	3 *(1)*	3 *(1)*	**27**	***(13)***	**40**
Turkey												
UK	1 *(1)*	1 *(1)*	1 *(1)*	2 *(4)*	1 *(1)*	1 *(1)*	1 *(1)*	1 *(3)*	1	**10**	***(14)***	**24**
US	5 *(7)*	3 *(6)*	3 *(5)*	5 *(1)*	4 *(6)*	3 *(6)*	4 *(6)*	9 *(12)*	3	**39**	***(65)***	**104**
EU	2 *(8)*	*(10)*	*(6)*	1 *(7)*	*(7)*	*(6)*	*(6)*	1 *(10)*	4		***(66)***	**70**

Data from 1999 policies. Note, totals in Tables 11 and 12 are not identical as many policies affect multiple sectors, and are listed as a separate policy in each sector on which the reporting country anticipates an emissions impact.

ENERGY EFFICIENCY POLICIES

Originally called upon to improve energy security, energy efficiency has emerged during the 1990s as one of the major options to meet environmental goals. Further to their commitments to the 1997 Kyoto Protocol, the IEA Energy Ministers at their 1999 meeting stressed the importance of energy efficiency. Accelerating energy efficiency improvements is seen as a key element in CO_2 policies in all IEA Member countries. During 1999, many IEA Member countries revisited and widened existing policies and measures for energy efficiency to cope with the challenges presented by climate change. These policies and measures range from building codes, appliance standards and labelling to increased dissemination of information and training.

The liberalisation of energy markets creates new challenges for energy efficiency policy. Until recently, electric utilities and, to a lesser degree, gas utilities have played an important role in disseminating information about energy use and encouraging customers to improve energy efficiency. These initiatives, known as Demand-side Management programmes (DSM), may now be in jeopardy in many markets. With deregulation, customers are no longer captives to a particular utility. This phenomenon forces utilities to reposition their DSM programmes and in many cases to scale them down. More competitive energy markets provide both new opportunities and new threats for energy efficiency.

The process of strengthening or redesigning policies to reflect new deregulated markets is still in its early stages. Best practice initiatives are one way to disseminate energy efficiency improvements resulting from increased competition. However, competitive markets may also create new barriers by locking in existing less energy-efficient technologies and practices, preventing more energy-efficient ways of doing things from entering and maturing in the market. Ensuring long-term energy efficiency in deregulated markets will require new innovative policies. One interesting example is the competitive tendering process in technology procurement that uses market forces to stimulate production and deployment of more energy-efficient technologies.

An important principle that was highlighted in the Energy Efficiency Initiative (IEA 1998) and recognised in the EC proposal to improve energy efficiency is the need to integrate energy efficiency into non-energy policy and programme areas[11]. Examples of areas used in the EC proposal are transport policy, regional and urban policy and programmes, international co-operation and pre-accession activities. We find, however, very few examples of such integration in our overview of IEA country policies.

National energy plans indicate the weight given to efficiency measures. The EC Action Plan sees the possibility of avoiding almost 200 million tonnes of CO_2

11. Communication from the European Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, "Action Plan to Improve Energy Efficiency in the European Union", TREN D1 17/399.

emissions per year through improved energy efficiency. This corresponds to about 40 per cent of the EU Kyoto commitment. Austria's study on "Options on how to achieve Kyoto targets" published in December 1999 includes a package of energy efficiency measures. Energy efficiency plays a major role in the new national plans for managing greenhouse gas emissions in Belgium, France, Ireland, Switzerland and Turkey. In May 1999, the Netherlands presented its *Energy Conservation Action Programme 1999-2000* that was accompanied by a large increase of the planned budget. In May 2000, the Danish Parliament passed a new energy savings act.

Residential/Commercial Sector

Building codes and standards are key instruments for implementing energy efficiency in the residential and commercial sector. Many countries (e.g. Australia, Canada, Finland, France, Germany, Ireland, Portugal, Spain, Sweden, the United Kingdom and Switzerland) are strengthening their building codes. Members of the EU are adapting their legislation to comply with the European directives on energy efficiency standards for household appliances and equipment and on mandatory energy labelling. In October 1999, Australia introduced minimum energy performance standards for a number of electric appliances and is developing, in consultation with the manufacturing industry, a national scheme for mandatory energy labelling for major domestic appliances. In Finland, technology procurement organised by *MOTIVA* to promote new windows, refrigerators and lighting has been particularly successful. In Sweden, the Swedish National Energy Administration (STEM), initiated 30 technology procurement projects: a recent in-depth evaluation showed that procurement produced a clear technology leap for refrigerators/freezers and accelerated the mass-production of low-energy appliances but failed in the case of high-performance windows.

Financial/fiscal incentive schemes are used mainly to encourage retrofitting, but in some countries, this support has been limited or even discontinued. In contrast, information and education activities are increasing, and there is a trend to decentralise these activities within a country, for example, in Austria, Belgium and Sweden. In 1999, Germany increased funds for energy consultant services for consumers, small and medium-size enterprises and builders.

Industry

Voluntary agreements to promote energy efficiency in industry are already in place in many IEA Member countries and are being increasingly adopted. They are the results of negotiated performance goals between government and industry, and, as such, they are regarded as conforming to a free and competitive market. In the Netherlands, a benchmarking agreement has been contracted recently with companies in energy-intensive industry, as a variant on earlier voluntary agreements. The purpose of this benchmarking agreement is that the processing plants of the participating companies become and remain among the best in the world in terms of energy efficiency. Negotiations are under way in France and the United Kingdom to set up new voluntary agreements, and Denmark and New Zealand are implementing agreements as part of their environmental policies. Targeted information programmes, such as seminars, workshops and training courses to disseminate information and experiences on energy efficiency, are also being widely developed in Denmark, Sweden, United Kingdom, Belgium, Ireland and Japan. Utilities are actively developing demand-side management and integrated resource planning in Australia, Austria, Belgium, Denmark, France, Germany, Italy and Spain. Market transformation and technology procurement focus on industry output, exploiting market competition to stimulate development and deployment of energy-efficient consumer products.

Public Sector

Public authorities in many IEA countries have actively sought energy efficiency improvements in public buildings and operations. Examples include the *Federal Building Initiative* in Canada and the *Energy Efficiency and Resource Conservation Challenge* programme in the United States, which encourages federal agencies to buy products in the upper 25 per cent of energy efficiency. The Commonwealth Government of Australia demonstrates best practice within its own operations in buildings. In 1999 Ireland published guidelines for the design and construction of social housing. France launched thermal improvement actions through partnerships between municipalities and the public bodies concerned.

Transport

The transport sector is probably the sector in most need of rethinking efficiency policies, but few new programmes are emerging. The Japanese "top runner programme" that applies to a whole range of energy-using products is an interesting initiative using market forces, and its application to the transport sector has attracted considerable interest. The revised Energy Conservation Law of June 1998 requires the Japanese Government to set further strict efficiency targets for automobiles. Voluntary agreements on national average fuel consumption are concluded or being considered in Australia and Canada. In the United States, the Partnership for a New Generation of Vehicles is a joint government-industry R&D initiative for developing an advanced technology vehicle. However, the US Congress has forbidden the Department of Energy to update the standards for Corporate Average Fuel Economy (CAFE). Urban and land-use planning would enable public transport to play a more substantial role, but 1999 saw few new initiatives. One of those few was a pilot project for transport planning launched by the Flemish region in Belgium.

Monitoring and Evaluation

The IEA's In-depth Reviews of energy policies have consistently emphasised the need to monitor and evaluate energy efficiency measures. IEA Member countries, whose energy efficiency policies rely heavily on long-term agreements, such as Denmark, Finland, the Netherlands and New Zealand, consider monitoring and evaluation as essential parts of this process. Canada, Portugal, Spain, Sweden, Switzerland and the United Kingdom carry out regular assessments of their energy efficiency programmes. Continuous monitoring and reporting are the keys to the success of all the voluntary programmes implemented in the United States. As part of the elaboration of its *Programme National de Lutte contre le Changement Climatique*, France carried out a systematic evaluation of its energy efficiency programmes (*Souviron* and *MIES* reports). New Zealand's *Energy Efficiency and Conservation Authority (EECA)* operates by informing and facilitating competitive markets, searching to minimise the interventions on these markets. Monitoring and evaluation is done at the level of individual programmes, but it has proven difficult to measure the full effect of the programmes on energy consumption and efficiency.

TECHNOLOGY AND RESEARCH AND DEVELOPMENT POLICY

Total government expenditures of IEA Member countries on energy R&D decreased from some US$9 billion at 1998 prices and exchange rates in 1990 to US$7.1 billion in 1998[12]. This decline represents a continuation, albeit less dramatic, of the trend already established in the 1980s and is largely associated with the difficulties of the nuclear industry and, since 1985, with the decrease in oil prices.

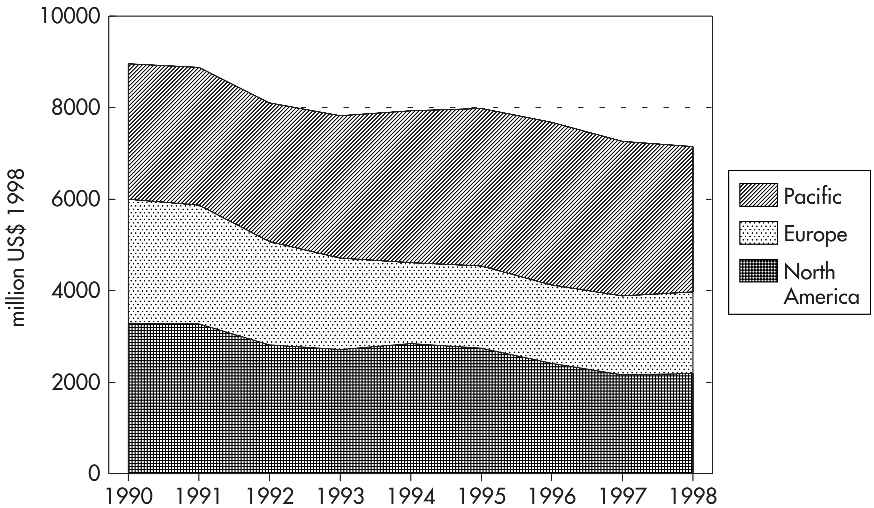
As Figure 38 shows, government budgets for energy R&D in both North America and Europe decreased by more than 30 per cent from 1990 to 1997, and then slightly increased, while the budget for the Pacific Region grew until 1996, and then fell slightly, but was still 7 per cent up from its 1990 level[13]. Between 1990 and 1998, two countries (Japan and the United States) accounted for more than 65 per cent of total R&D government budgets in IEA countries. In 1990, the shares of total IEA spending for these two countries were nearly the same, with 33.5 per cent for the United States and 33 per cent for Japan, while a large group of European countries

12. The analysis in this section is largely based on the data collected by the IEA statistical office from the governments of Member countries on public spending in energy R&D. Considerations on quantitative trends are based on a smaller data set than the one actually available to the IEA because the government budget information is not available for all IEA countries for all years considered (1990-1998). In order to have a consistent data set, data from the following countries have been used:
    - for the North America region: United States and Canada;
    - for Europe: Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom and Turkey;
    - for the Pacific region: Japan and New Zealand.

    Finally, while considering the trends described here, the reader should be reminded of possible distortions introduced by the use of exchange rates to convert budgetary figures into United States dollars.
13. A few other countries kept increasing their R&D budgets (in real value) from 1990-1998, including Belgium, Denmark, Finland, Greece and Turkey. Given the relatively small size of their R&D budgets, their budgetary increases did not change the overall decline in Europe.

Figure 38

Government Energy R&D Budgets in IEA Countries, by Geographic Area



Source: Country submissions.

represented 30.2 per cent. In 1998, Japan represented 44 per cent of total energy R&D spending of IEA governments, and the United States accounted for 28.3 per cent, and IEA Europe for 25 per cent.

R&D budgets have significantly decreased in real terms in two areas: nuclear research (fusion and fission) and technologies related to fossil fuel extraction and transformation, as shown in Figure 39. Percentage shares of R&D by technology are shown in Figure 40. Nuclear technologies still remain at the core of public R&D spending in some of the largest IEA Member countries. But the relative share of nuclear technologies has decreased since 1990 until 1998 from 55.7 per cent to 50.7 per cent. Among nuclear technologies, the share of nuclear fission in government energy R&D budget decreased from 44.1 per cent to 40.3 per cent between 1990 and 1998, while the share of nuclear fusion went from 11.6 per cent to 10.5 per cent, with a remarkably constant relative share between fission and fusion, during the same period. At present, about 76 per cent of all fission-related research concentrates on the nuclear fuel cycle (in particular nuclear waste treatment) and on a variety of nuclear supporting technologies (from nuclear safety to decommissioning). Research on light water reactors (LWR) has not shrunk significantly while that on other converter reactors was compressed to one-fifth, and that on breeder reactors to 30 per cent of their 1990 levels.

Government expenditure for fossil fuel research experienced the largest drop in share from 19.2 per cent in 1990 to 8.3 per cent in 1998. In percentage terms, research expenditures on oil and gas did not suffer a visible reduction, while the

Figure 39

Government Energy R&D Budgets in IEA Countries, by Technology Area

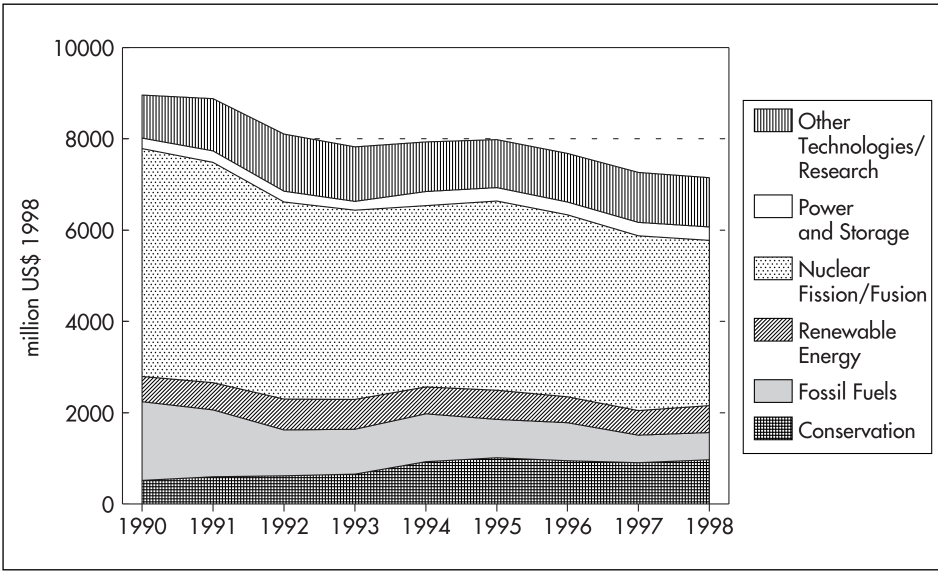
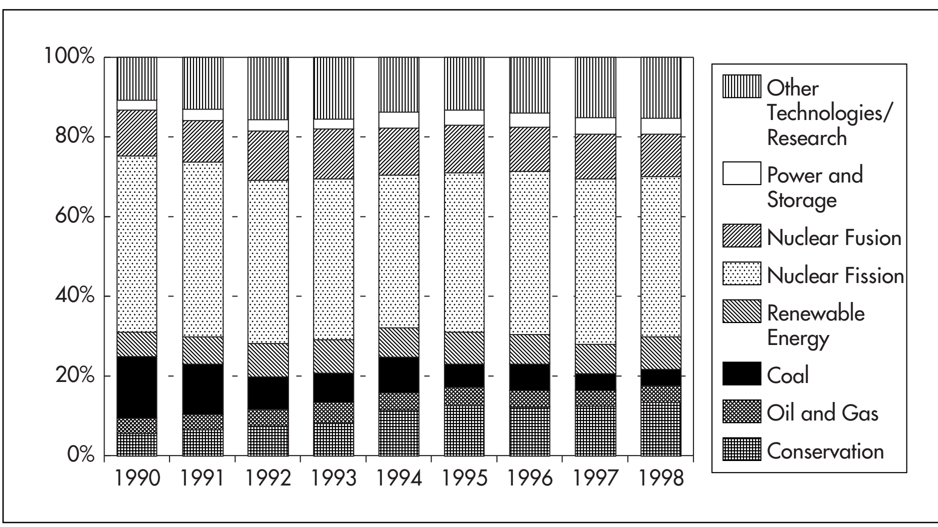


Figure 40

Government Energy R&D Budgets in IEA Countries: Technology Shares



Source: Country submissions.

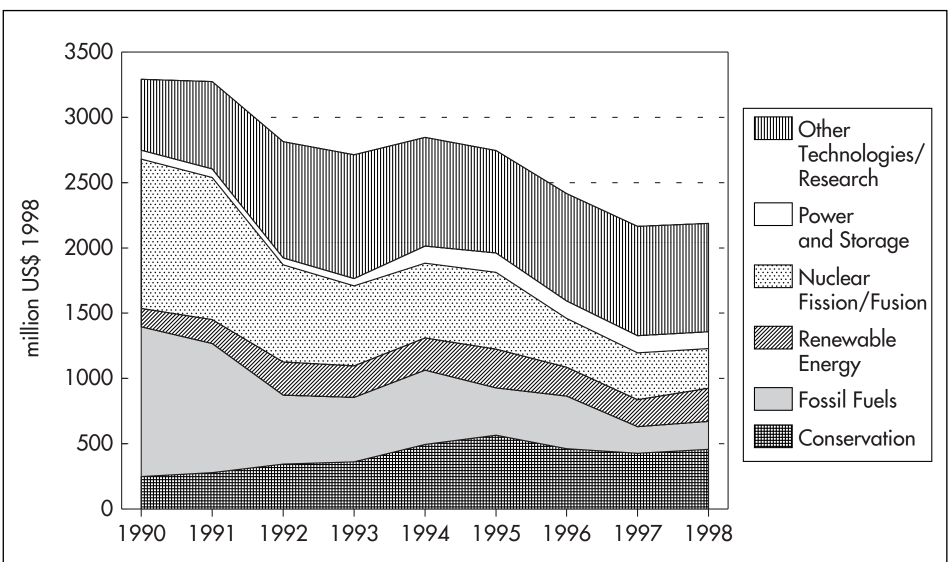
brunt of the reduction fell on coal research, in particular those related to coal and lignite exploration and production techniques. Although this reduction may be related to the decline in coal use in industrial countries, the use of coal for electricity generation is expected to increase in developing countries. Therefore, research activities on coal combustion (in particular, high efficiency technologies for power generation) and on conversion remain important, especially in light of transferring technologies to developing countries.

The share of renewable energy in government R&D budgets of IEA countries grew slightly from 6.1 per cent in 1990 to 8.2 per cent in 1998. Favoured options in the allocation of funds were solar photovoltaic, biomass and wind. Energy conservation technologies received more government support in 1998 than in 1990 with their share increasing from 5.8 per cent to 13.6 per cent of the total R&D budget. Public resources for power and storage technologies increased from 2.6 per cent in 1990 to 4.1 per cent in 1998, and expenditure on other technologies and research areas grew from 11 per cent in 1990 to 16 per cent in 1998.

North America showed the most dramatic shifts in research priorities over the period, while in resource allocation the other two regions remained stable. In North America (Figure 41), there were drastic reductions in R&D funding for fossil fuel research (falling from 35 per cent in 1990 to less than 10 per cent in total government R&D for energy technology in 1998), reflecting a deep cut in coal research, in particular coal and lignite exploration and production techniques. Nuclear fission research budgets were curtailed from 23 per cent in 1990 to 4 per cent in 1998, after a prolonged moratorium on new nuclear plant. Nuclear research funding also declined in the 1980s, for example, the US research budget for fission

Figure 41

Government Energy R&D Budgets in North America, by Technology Area



Source: Country submissions.

technology in 1990 was one-fourth, in real terms, of the 1979 budget, at the time of the Three Mile Island accident. The United States has recently begun a new research initiative focused on innovative nuclear energy concepts. In contrast to fission technology, support for fusion technology started to decrease only after 1995, but it has nearly halved since then. Public resources have been increased, both as a percentage of the total budget and in real terms, for energy conservation technologies (from 7.5 per cent in 1990 to 20.9 per cent in 1998), and for renewable energy (from 4.3 per cent to 11.5 per cent). The government budget for "other technologies and research", which mainly includes crosscutting technologies and some research on hydrogen, increased from 16.5 per cent in 1990 to 37.9 per cent in 1998.

In OECD Europe, research on nuclear technologies received high priority, keeping more than 50 per cent of total government funding for energy R&D (53 per cent in 1990 to 55.6 per cent in 1998). In R&D budgets for nuclear, about 70 per cent went to fission research and the rest to fusion. Fission R&D activity concentrated on LWR technology, nuclear fuel cycle waste management, safety and decommissioning. Energy conservation increased its share from 9.8 per cent in 1990 to 12.6 per cent in 1998, although it did not enjoy an increase of resources in real terms. The situation was similar for renewable energy technologies, whose share of the budget increased slightly from 11 per cent to 12.8 per cent over the same period. Power and storage technologies increased their share from 2.7 per cent in 1990 to 5.6 per cent in 1998 with an accompanying real increase of resources. Fossil fuels and "other technologies and research" lost (in real terms) more than half of their resources over the same period.

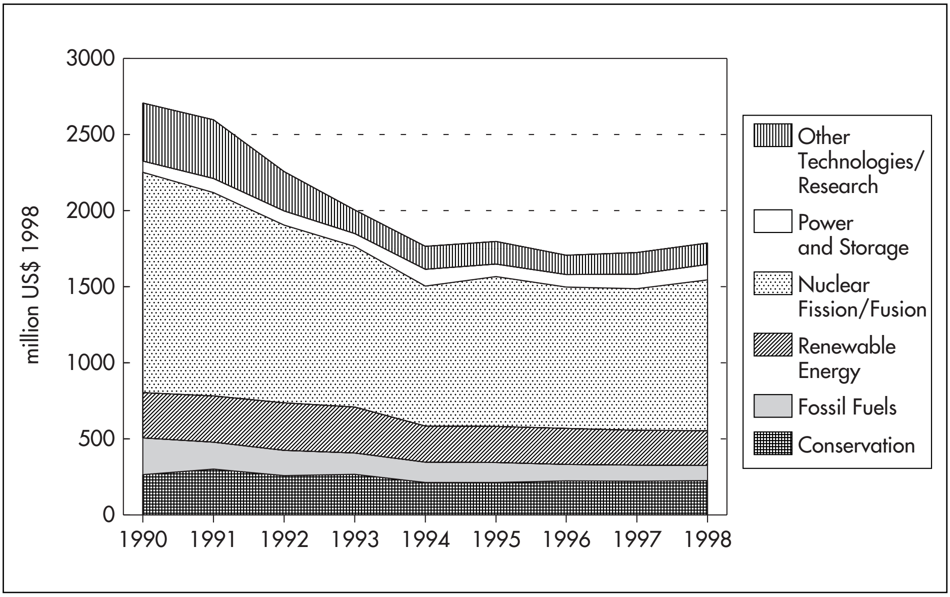
The research portfolio of the OECD Pacific region is less diversified than in North America and OECD Europe (Figure 43). Over 73 per cent of total government energy resources in 1998 went to nuclear research, although this share decreased from 81 per cent in 1990. About 90 per cent of the total resources for nuclear research went to fission research (in particular on the nuclear fuel cycle and nuclear supporting technologies) and the rest to fusion. In 1998, conservation technology received 9.1 per cent of total government R&D for energy technologies, and fossil fuels received 8.8 per cent, with the majority of resources directed at the use of coal. Renewable energy technologies accounted for 3.5 per cent of the total government budget for energy R&D in 1998, while power and storage technologies and "other research" received 2 to 3 per cent each.

Energy R&D expenditures by IEA governments have declined over the past two decades. With the possible exception of Japan, there are no signs that governments may be engaging more in basic research, at least as a percentage of GDP[14]. On the other hand, very little information is available on private industry R&D budgets for energy technologies. The private sector may be replacing the decreased involvement of government, but this is difficult to confirm. There is evidence that,

14. Trends in basic research would not show in the IEA statistics, but can be analysed with the help of OECD data. See *"Science, Technology and Industry Scoreboard – 1999", OECD,* page 130.

Figure 42

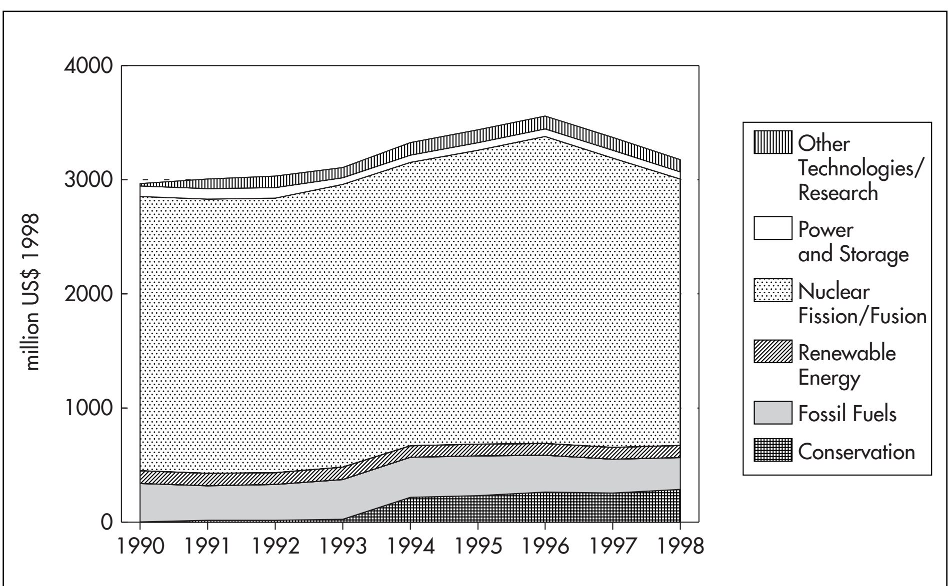
Government Energy R&D Budgets in Europe, by Technology Area



Source: Country submissions.

Figure 43

Government Energy R&D Budgets in the Pacific Region, by Technology Area



Source: Country submissions.

following the process of market liberalisation, many electric utilities have reduced their involvement in R&D. Research in the energy system manufacturing industries, on the other hand, may still be important, but only in the most visionary cases does it look beyond a four-year horizon. In fact, as industry has increasingly focused on shorter-term R&D, government collaboration with industry has had the effect of shifting some government funding away from longer-term R&D and of focusing funds on the stage immediately before commercialisation. Some Member governments have encouraged private R&D spending through increased use of fiscal incentives (tax breaks, etc.), but these measures are not likely to induce a major shift in industry towards longer-term research. Although government energy R&D budgets have recently increased in the United States and Europe, there remains a concern that insufficient resources have been allocated for medium- and long-term options to meet energy policy objectives, including global climate change mitigation. Some IEA consultative bodies have been suggesting that IEA governments should find a more balanced R&D budget mix that focuses on the more long-term policy objective of sustainable development.

ENERGY POLICY DEVELOPMENT IN NON-MEMBER COUNTRIES

Non-Member Countries Face High Energy Demand Growth

Energy demand in non-OECD countries is expected to rise from some 3,861 Mtoe in 1997 (44 per cent of the world total) to nearly 7,634 by 2020[15] (56 per cent of the world total) representing an average annual growth rate of 3 per cent. Energy demand in a number of non-OECD countries is expected to increase even more by some 4 per cent per year. In contrast, energy demand in OECD countries will grow by about 1 per cent per year over the next two decades.

Quite a few non-OECD countries are endowed with potential energy resources sufficient to meet their demand growth. But some of the larger energy-consuming countries expect their energy import dependency to increase dramatically: e.g. China, after becoming a net oil importer in 1993, expects its oil imports to soar from 1.3 mbd currently to 8.4 mbd by 2020, outstripping import demand in many OECD countries. The country's TPES is projected to more than double to 1,937 Mtoe by 2020.

Capital Needs of Non-Member Countries

Non-OECD countries are competing for capital to develop their energy sectors to meet one or several of the following goals:

15. IEA, *World Energy Outlook 2000*, Paris.

- to boost their energy export capacity and export revenues (e.g. Middle East and other oil producers, like Russia);
- to help meet their rapidly growing energy needs (e.g. China, India, Mexico);
- to diversify or to reduce their dependence on energy imports (Brazil, Eastern Europe, Southeast Asia);
- to diversify their energy mix.

The competition for scarce capital was exacerbated in early 1999 when the oil price collapsed and the poor performance of oil stocks led to cutbacks in international exploration budgets of oil companies. The consolidation wave in the oil industry reduced the number of potential investors, especially in capital-intensive frontier basins.

For more than a decade, petroleum-exporting countries have periodically adjusted investment terms for firms to explore and produce hydrocarbons, particularly in high-cost or technically challenging areas such as deepwater offshore West Africa. As a result, new countries, such as Equatorial Guinea and Sudan, have started producing oil. Production-sharing agreements (PSA) have emerged as the most favoured type of agreement for companies. In 1999, progress was made in Brazil, where sizeable acreage and reserves formerly held by state-owned Petrobras were licensed to private companies. Other efforts include the determination of the Nigerian Government to honour the financial commitments of state company NNPC in joint ventures with foreign companies and the apparent willingness of the Russian Government to make broader use of PSA's to rekindle investment.

Even major low-cost oil-producing countries are turning to foreign companies for capital. Saudi Arabia's recent overture to allow foreign investment in its energy sector except in its upstream oil sector, demonstrates how oil-exporting countries have had to increasingly rely on foreign capital to develop and diversify their economies and to sustain their production capacity. Kuwait has also considered opening its oil sector, but Parliament has questioned the transparency of the procedure proposed by the government. Libya has recently made oil investment offerings. Facing competition for capital from other low-cost OPEC producers, Iran has realised that "buy-back" project terms will need to be sweetened to encourage investment.

Nigeria estimates that $35 billion are needed over the next five years to maintain and develop its oil industry. Investment into Iran's oil sector will total $10 billion over the next five years. At least $10 billion are expected to be invested in gas projects in Asia over the next decade. Russian gas production declined in 1999, mainly because of insufficient expenditures to develop new reserves. Gazprom estimates its investment needs at some $60 billion over the next decade.

Numerous countries are grappling with chronic electricity outages (e.g. Ukraine, Nigeria, Kenya and Mexico) because of the decrepitude of their infrastructure. The capital requirements for modernisation and expansion of electricity infrastructure are staggering: up to $60 billion in Russian generation and transmission; several tens of billions of dollars in Saudi Arabia, largely for gas-fired power; some $15 billion per year in India; $4.4 billion per year in Brazil until 2008; and $45 billion in Mexico until 2007.

Ever More Non-Member Countries Realise Benefits from Energy Sector Reform

Many of the energy sector reforms in the 1990s were devised to attract investors for export-oriented projects. More recently, many countries have become aware that reform is needed for domestic investment projects. These reforms are aimed at creating conditions for investors – mostly foreign, sometimes domestic – to prosper on the domestic markets. They include market opening, breaking up and unbundling state energy monopolies and privatisation of state assets, adequate regulation and decontrolling energy prices to allow investors to earn an adequate return on investment by selling energy domestically.

Reforms are also intended to increase efficiency and to lower energy costs. In many countries with heavily subsidised energy prices, reduced production costs are not visible to the customer, whose energy bill will increase as subsidies are removed. Many countries have had no choice but to sell off bankrupt utilities. In some countries liberalisation has led to worrisome market consolidation (e.g. Brazil's private electricity distribution; Argentina's oil retail sector after the purchase of YPF by Repsol in 1999).

International obligations, such as WTO membership, can accelerate reforms in some countries. Regional organisations can also act as catalysts for reform, such as when the EU obliges East European accession candidates to adapt to the EU electricity and gas directives. The proposed Mercosur energy market has also been a catalyst for reform as have conditions for loans requested by the international financial institutes.

De-Monopolisation, Deregulation and Privatisation

Many countries have taken steps to allow foreign investors more access to indigenous energy markets. Nonetheless, dissolving a national monopoly remains a very debated issue and is frequently slowed down by various types of resistance such as strikes (e.g. union protests against utility privatisation in India and South Africa) or institutional obstruction (e.g. Nigerian state utility NEPA opposing IPPs). Frequently the state retains control over transmission or some of the generation capacity. In some cases, the state-held monopoly is maintained, while creating an adequate investment framework for independent power producers (IPPs).

Many countries, including Mexico and some countries in Eastern Europe and the former Soviet Union, have set up regulatory agencies. Kazakhstan has unbundled its electricity monopoly and sold 80 per cent of generation capacity over the last four years. Georgia has successfully sold parts of its electricity industry. The break-up of Russia's electricity monopoly UES remains very controversial, and, so far, opening of the company's equity has not raised sufficient capital. Ukraine is cautiously planning a second round of sales of regional distribution companies, after investors in a 1997 sale failed to fulfill their investment pledges. Bulgaria and Romania are slowly forging plans to sell their national electricity companies.

The Philippines, which suffers from some of the highest electricity prices in Asia, is passing legislation to privatise state-held Napocor. India, whose potential electricity demand exceeds generation by more than 6 per cent, has set up regulatory agencies in 15 states and will allow privatisation of distribution companies in some states in 2001. Korea's electricity monopoly, KEPCO, will soon be unbundled and the generation sector will be privatised in 2002. Oman envisages floating some of its electricity assets. In Pakistan, sales of electricity distribution companies will resume under the new privatisation law. Venezuela passed a new electricity law to reactivate the stalled sale of utilities. Zimbabwe is setting up a regulator with the goal of introducing competition in its electricity sector by 2002.

Certain countries have reduced state control over the oil and gas sectors; Indonesia has stripped Pertamina of its oil retail monopoly. Korea plans to split up its state company, KOGAS, and to sell the LNG import and wholesale business in 2001. In China, two vertically-integrated companies – CNPC in the north and Sinopec in the south – were created to reduce government control over the oil sector.

Bolivia's oil company, YPFB, was privatised recently. Lithuania sold a minority stake and surrendered control over its national oil company, Mazeikiu, in 1999. Poland sold its refineries and is considering spinning off assets of the company which controls oil and gas upstream operations and transportation. After selling some of its refineries, Romania has had contacts with potential buyers for its national oil company, Petrom. Bulgaria sold its largest refinery, but has postponed the sale of its gas firm, Bulgargaz until 2006. Slovakia has sold its major oil refinery and is attracting investors for its gas transmission company, SPP.

Reform of Energy Price Control

Decontrol of energy prices is probably the thorniest reform issue in non-OECD countries, mainly because of the social hardships that result from lifting subsidies and from price hikes. Below-cost energy prices deter domestic investment. Export-oriented projects, typically oil and gas, face export barriers such as taxes or quotas imposed by host governments to protect domestic markets, e.g. in Kazakhstan. Low electricity prices can be a threat to Independent Power Producers (IPPs) where industry tariffs cross-subsidise households, or where the wholesale market or transmission remains under state control (e.g. in Indonesia). Even in the absence of foreign companies, local producers are often tempted to smuggle their production into neighbouring lucrative markets (e.g. in Uzbekistan). Non-payment and theft, which in countries like India, Russia and Ukraine affect up to two-thirds of distributed electricity or gas, can bankrupt energy companies.

In non-OECD countries, domestic fuel prices are higher than world fuel prices. The disparity is greatest in China, whose 1998 programme to scale oil prices down to world levels by end 1999 had to be deferred due to low international prices in 1998-early 1999 and rising production costs at home.

In 1999 the IEA carried out a study on energy subsidies of eight large energy-consuming non-member countries[16]. It revealed pervasive energy subsidies, mainly for gas and electricity. Average subsidisation ranged from 6.4 per cent in South Africa to 80.4 per cent in Iran. The key findings of the study were that abolition of energy subsidies and the resulting energy efficiency gains in the eight countries could reduce global energy consumption by 3.5 per cent and CO_2 emissions by 4.6 per cent.

Realising how investment-hostile low energy prices are, many countries have cautiously brought energy prices closer to cost recovery, but several have faced strikes or social strife as a result (Nigeria, Egypt, Venezuela, India, Ecuador).

Fuel Switching to Gas

Many countries, particularly in Asia and Latin America, are restructuring their energy balance, usually from coal or oil to gas. The relative proximity and abundance of proven gas reserves (e.g. in Southeast Asia and in the southern cone of Latin America) makes gas an attractive choice, as does pricing and cost considerations and its environmental acceptability. The gas option is further enhanced for Asian economies, which are likely to be burdened by costlier Middle East oil imports in the near future. Heavily hydropower-reliant countries such as Brazil, Chile or Ghana welcome gas to forestall shortages arising from low precipitation. In its diversification efforts, China has embarked on major gas infrastructure projects to move gas from its western Tarim basin to consuming areas in the East. The introduction of more stringent legislation limiting the flaring of associated gas will further boost gas production in countries such as Nigeria, Kazakhstan or Syria.

Mexico is planning to build gas pipelines from the US and Canada to help meet an expected 10 per cent annual growth in gas demand, while the state oil and gas company, Pemex, has declared gas exploration its top objective. Brazil's soaring electricity demand is to be largely covered by new gas-fired plants. Gas is gaining market share in Latin America's southern cone, stimulated by rising production in Argentina and Bolivia and by trans-border gas trade through a number of recently

16. Analysis was carried out for China, India, Indonesia, Iran, Kazakhstan, Russia, South Africa, Venezuela. (*World Energy Outlook, 1999 Insights – Looking at Energy Subsidies: Getting the Prices Right*, OECD, 1999.)

completed pipelines (e.g. Argentina-Chile and Bolivia-Brazil). However, development of Latin America's largest gas field, Camisea in Peru, has been delayed because the national utility, Electroperu, has failed to ratify a gas purchase agreement. Indonesia, Malaysia and Thailand are pondering gas-promoting energy policies. Bangladesh recently started gas production, while the Philippines are scheduled to bring their first major gas field on stream in 2001. Even the Middle East oil exporters are facing a rapidly rising gas demand: some 80 per cent of Saudi Arabia's future electricity generation capacity will be gas-fired. Gas demand will double by 2020 in the Persian Gulf states and will be covered by the recently signed Dolphin project, fed by Qatari gas.

Growing Gas Trade

The increasing attractiveness of gas worldwide has led to rising gas trade volumes both by pipeline and LNG, i.e. a 13 per cent increase in 1999 to 532 bcm over its 1998 level. Russia, the world's largest gas exporter, increased gas exports by 5.2 per cent in 1999, in spite of a 0.1 per cent decline in production. Myanmar started exporting gas via pipeline to Thailand in 1998. Trinidad & Tobago started exporting LNG in 1999 as did Oman in 2000. In Southeast Europe, pipeline gas deliveries to Greece and FYROM (Macedonia) began in recent years. Smaller-scale, but regionally important trans-border gas transport is projected in Sub-Saharan Africa, with Mozambique and possibly Namibian gas exports to South Africa, and probable Nigerian gas to its western neighbours. At the periphery of Europe, several established gas exporters (Russia and Algeria) or potential ones (Azerbaijan, Egypt, Libya, Iran) are competing for market share in Europe, and, particularly in Turkey, which is Europe's fastest growing energy market.

Several factors impede or suppress gas trade. Political impediments to trans-border gas trade remain, most noticeably in Southern Asia, where Bangladeshi exports to India or Turkmen exports to Pakistan and India have failed to materialise. Azerbaijan's Shah-deniz gas strike has contributed to the foundering of trans-Caspian gas exports from Turkmenistan. Russia's Gazprom has barred Turkmen gas from reaching solvent markets until late 1999 and is building new pipelines to Poland and Turkey, bypassing transit countries such as gas-debt-ridden Ukraine. The discovery of new gas reserves sometimes lessens the need for regional gas trade. For example, new gas reserves offshore Israel seem to have made Egyptian gas imports superfluous.

Some Countries Foster Coal

The closure of unprofitable mines has been ongoing in Poland, China, Russia and more recently Ukraine. Mine closures, and sometimes even new capacity, continue to be subsidised. In 1999, Russia nearly doubled its coal subsidies to close 60 mines, in order to achieve its mine-closure programme in 2000. Commissioning of new efficient facilities in Russia yielded a 7 per cent production hike in 1999 and should help end production subsidies in major coal districts by 2001-02. Russia's new bullish long-term energy strategy calls for a doubling of coal output by 2020. Other countries with expanding coal sectors are Indonesia and Colombia, which plans to boost export of its low-cost coal to North America and Europe by partly privatising state-owned Carbocol.

Nuclear Power

Three Eastern European nations have decided to close Soviet-design nuclear reactors that pose safety concerns in order to comply with conditions to join the EU. Lithuania will close its first block at Ignalina in 2005 (a second block will be closed before 2009) and Bulgaria will close two reactors of its Kozloduy plant by 2002 (two more reactors will be closed at a later date). Ukraine, under pressure from Western countries, announced that it would close the remaining unit at Chernobyl in December 2000. The financing of the decommissioning and the alternative to replace Chernobyl generation capacity still need to be resolved. Armenia's Medzamor plant is another source of concern, but limited energy resources have prevented the government from fixing a closure date.

While some OECD European countries have opted to abandon nuclear power over the longer term, most new nuclear power generation capacity will be commissioned in non-OECD countries. New units are nearing completion in India, Brazil, Korea and Slovakia. Romania is re-activating plans to complete its second Canadian-design reactor at Cernavoda. Russia's long-term energy strategy attributes a major role to nuclear energy, with 38 new reactors to be built by 2020 at a cost of $32 billion. There are doubts, however, about their financing. South Africa is seeking to develop its own nuclear technology[17].

Access to Commercial Energy

One perfidious consequence of subsidised energy prices is that they deprive utilities of revenues, which are needed to connect parts of the population to the grid. Some 1.6 billion people – 30 per cent of the world's population, all in non-OECD countries – do not have access to commercial energy. Efforts to expand the use of commercial energy, particularly in rural areas, are insufficient. Although some 300 million people have been connected since 1993, the number of people with no access to commercial energy continues to grow and is expected to reach 2 billion by 2020.

Energy Efficiency, Renewables and Environmental Issues

Energy efficiency does not always appear at the top of the government agenda in many countries outside the OECD, despite the fact that energy efficiency in many of them is below the OECD average and many cities in developing countries are choked by traffic and industry emissions. Laudable policies do exist, such as the

17. Pebble-bed Modular Reactor.

legal obligation for Brazilian utilities to invest 1 per cent of turnover into energy efficiency projects and R&D. A 1999 IEA study[18] shows that removal of subsidies in eight major non-OECD countries would lead to a significant reduction in energy intensity from 1.1 toe to 0.96 toe per $1,000 of GDP.

Non-OECD countries are generally wary of climate change mitigation policies. They apprehend future mitigation commitments as an obstacle to their own economic development. Large oil exporters fear that their exports will be affected by mounting climate change concerns. Some nations are, however, preoccupied by potential sea level rise or increased aridity. Per capita greenhouse gas emissions in non-OECD countries are far below emissions in OECD countries.

The rapidly rising energy demand in non-OECD countries can only be met by large fossil fuel-fired projects. Renewables are expected to make only a marginal contribution. Small initiatives, like the launch of Morocco's first major wind power station, which will provide 2 per cent of national electricity, or the installation of 150 thousand small wind generators in rural areas of Inner Mongolia (China) are laudable but will have little effect on energy demand choices. Local environmental concerns are often more pressing than global climate issues, and are addressed by initiatives such as the replacement of diesel by electric or LPG vehicles in cities such as Katmandu or Hong-Kong.

18. *World Energy Outlook, 1999 Insights: Looking at Energy Subsidies: Setting the Prices Right*, OECD, 1999.

2

PART

THE COUNTRY REPORTS

IN-DEPTH REVIEWS: SUMMARIES

Part 2 contains summaries of the findings and the full list of recommendations of the 2000 in-depth reviews. The full reviews have been published separately.

CANADA

Canada's endowment of all forms of relatively low-cost energy resources has made possible the development of an energy economy based on energy-intensive industries, and has given rise to Canada's role as an energy supplier to the US, and as a coal and nuclear technology supplier to Asia. The distribution of resources between the provinces and the separation of jurisdiction for the energy sector has led to different patterns of development in the provincial energy sectors and to marked differences in energy policy between the provinces.

Canada's plentiful hydro and uranium resources, coupled with the development of the CANDU technology (heavy water reactor system), have enabled the development of an electricity generation industry based largely on renewable and carbon-free fuels.

GENERAL ENERGY POLICY

Because of the division of powers over energy between the federal and provincial governments, the federal government provides a framework for the sector as a whole, but does not seek to determine policy in all areas. The focus of federal policy has been on sustainable development issues and energy efficiency. Regulatory reform in the electricity and gas industries (other than international and interprovincial trade) has been largely a function of the provincial governments. Policy is co-ordinated through formal high-level committees and informal contact between the federal and provincial governments. The federal government has primary responsibility for the nuclear industry. The provincial governments own the Crown mineral rights within their jurisdictions and constitutional responsibility for management and development of the resources. The focus of their energy policy is on resource management, economic development and on securing a fair share of the economic rent as royalties. The governments of the territories, where the federal government has responsibility for energy mineral development, are focused on the economic development of the resources.

Responsibility for regulation is shared between the federal and provincial governments. Federal regulatory powers are strong with respect to international and interprovincial trade, but market outcomes are generally endorsed. Electricity development has tended to be based on large, provincial Crown corporations, although this is changing.

Physical energy security is not an issue in Canada because of its huge and diverse energy resource base. Although no problems have arisen to date, strong growth in gas production and exports will continue and there is potential for developing gas resources in remote locations. Markets require good information to operate effectively and governments in Canada play an important role in analysing market trends. Government agencies should ensure that market players are receiving adequate information on emerging gas transmission capacity requirements to ensure the timely and efficient expansion of gas infrastructure by private parties.

ENERGY-ENVIRONMENT POLICY

Canada faces potentially high economic costs involved in meeting mandatory greenhouse gas emission targets, depending on the time frame for compliance and the instruments used. Canada has generally opted for voluntary measures supported by information programmes, market incentives and energy-efficiency standards. Additional measures are being designed to meet the diverse needs of the provincial energy sectors. The federal government has given a commitment that no region should be asked to bear an unreasonable burden. In the build-up to the implementation window for the Kyoto Protocol, it will be important for the federal, provincial and territorial governments, and stakeholders, to demonstrate the effectiveness of measures preferred by Canada.

Possible new measures are being developed by government-industry working groups, called "Tables". Without the measures already in place, Canada's probable level of emissions would be about one-third higher. It is likely that stronger measures will be necessary to enable Canada to achieve its target.

The Tables process is a "bottom-up" process that should produce useful and practical proposals, based on a common understanding and analysis by all the parties. As part of the process, the Analysis and Modelling Group (one of the Tables) has constructed the modelling structure necessary to analyse the economic, environmental and social impacts of various paths to achieving the Kyoto target. It will be necessary to translate this work into a coherent package of measures which has support from all levels of government. The federal government should continue to work with the provinces towards the goal of developing an integrated implementation strategy, based on its overall analysis of the task. It should encourage the private sector to pursue least-cost abatement measures, including the international flexibility mechanisms, i.e., joint implementation, Clean Development Mechanism and emissions trading. It should tentatively quantify the potential contribution of these to achieving the Canadian target.

ENERGY EFFICIENCY

The Office of Energy Efficiency has been established as the core unit responsible for delivering energy efficiency components of the Efficiency and Alternative Energy Program (EAE). Its restructured programme management, based on programme outputs and outcomes and market outcomes, has increased the transparency and accountability of the programme. The use of disaggregated sectoral energy efficiency and use indicators, and their continuous evaluation and development, is commendable.

Comprehensive regulation for appliances and buildings, supplemented by labelling, are in place in the residential and, to a lesser extent, in the commercial sector. Standards, codes and regulations cover a large share of household energy consumption and achieve – where they are of a mandatory nature – a high penetration in the market. Provided widespread adoption in the provinces can be assured, this approach should have a positive impact on energy consumption and carbon dioxide emissions despite significant growth in population and income. In the commercial sector, the effect is less marked.

In industry and transport, EAE measures rely largely on increasing awareness through targeted information and suasion mechanisms (such as voluntary commitments) for the uptake of energy efficient practices. Where behavioural changes are intended, such as in transportation, information and awareness-raising measures alone are not likely to achieve sufficient uptake and penetration of changed practices. At least in some industry sectors, rates of improvement in efficiency do not appear to be significantly higher than what could be expected without government measures. With the detailed information of past intensity changes in industry available, and the voluntary mechanisms well in place, the government should strive to encourage stronger commitments, if the overall doctrine of voluntary action is to be maintained.

The uptake of the existing, well-developed programmes could be enhanced greatly by introducing additional market-based measures. In the end-use area, the integration of existing programmes with further market-based measures is necessary to maximise their impact. The recent commercial buildings incentive programme is an example of how this might be undertaken. More stringent voluntary commitments might be negotiated in place of fiscal/regulatory requirements where competitive disadvantages for industry are expected.

New measures to improve energy efficiency are likely to emerge from the Tables process. A further strengthening of the current energy efficiency programme appears likely. The development of indicative emissions reduction objectives and targets for end-use measures, could be an initial step that would then allow a further strengthening, tailoring and prioritisation of programme measures.

The provinces have jurisdiction in many areas which federal energy efficiency programmes seek to influence. The effectiveness of federal programmes may be inhibited by their incomplete uptake in the different provinces. Closer integration of the approach taken by the federal, provincial and municipal governments would be consistent with evolving competitive energy markets.

MARKET REFORM – ELECTRICITY AND GAS

Electricity market reform has been very successful in some provinces. Some provincial governments have developed liberalised markets within provincial borders. In addition to achieving provincial goals for jobs, investment and consumer benefits, electricity market liberalisation is being pursued to enhance access to US markets. Geography inhibits the development of a national electricity market in Canada, but there is already significant trade and potential for strong north-south regional markets, involving several provinces and adjacent US states. Interprovincial trade is not regulated. Utilities in adjacent provinces are free to enter into commercial transactions. Federal and provincial governments are in agreement on open transmission access across provincial jurisdictions.

The views of the US Federal Energy Regulatory Commission (FERC) have had a major impact on development of policy in Canada. It is likely that competitive markets will continue to develop in some provinces to bring about domestic competition and in order to gain broader access to US markets. This may require provincial market structures to conform, in part, with US Federal Energy Regulatory Commission policy despite objections (for example, from the Government of Alberta) to the extraterritorial application of FERC rules. The uneven pace of restructuring between provinces means that not all potential efficiency benefits will be realised and that investments in infrastructure could be sub-optimal. However, provinces have agreed to reciprocal access provisions in the Energy Chapter of the Internal Trade Agreement. Also, provincial regulators can be expected to facilitate investments in interconnection facilities where these would be in the consumers' interest. Similarly, the new market structures should enhance co-operation between provinces. For example, as part of electricity restructuring in Ontario, Ontario Hydro Services Company, which inherited the transmission and distribution assets of Ontario Hydro, is committed to using best efforts to expand the interconnection tie with Québec. Policies driven by provincial governments may lead to problems concerning planning for transmission and the promotion of market reform for the benefit of Canadian consumers in provinces where there is limited potential for trade, particularly with the US.

The current trend to integrate the US and some provincial markets will benefit the participating provinces and should therefore be encouraged. The policy objective should be to encourage the formation of efficient regional and international markets. Convergence of provincial markets will require the development of compatible principles under which emerging regional markets develop, if high transition costs are to be avoided and longer-term efficiency gains are to be maximised.

These considerations also have a bearing on gas. The upstream gas market is fully liberalised, and some provinces are now liberalising the downstream market. Some initial problems have been encountered in areas broadly described as consumer protection, which may affect public confidence in competition reform and the smooth transition to full opening of the domestic market.

Generally speaking, market outcomes are accepted and interventions in energy markets are exceptional. The regulator accepts freely negotiated transmission tariffs, and planning for new transmission capacity and overall assessment of security of supply are also left to the market.

OIL

Activity in Canada's conventional oil industry is gradually shifting from the mature producing areas in western Canada to the east coast offshore. It is uncertain whether conventional oil production will continue to rise as this change occurs. Growth in total oil production will depend upon increased production of bitumen and synthetic crude oil from the bituminous sands. The companies currently active in mining and upgrading of oil from the bituminous sands, led by Syncrude and Suncor, are able to produce light synthetic crude at a relatively high fixed cost, but low variable cost. Unlike production from a conventional reservoir, the mining of bituminous sands allows production at a fixed rate from a known resource, often using truck and shovel techniques. The present producers expect to be economic with oil prices at or above US$ 12 per barrel.

NUCLEAR

Nuclear power in Canada is based on the Canadian CANDU technology. Most reactors are in Ontario, where eight reactors were shut for extended periods following declining performance. No new reactors are planned to be built. Performance of nuclear power has a particular bearing on energy-environment policy as fossil fuels are presently compensating for lower nuclear output.

An extensive network of government activities, resulting from the domestic origins of the CANDU technology, backs the nuclear industry. Nuclear-related activities are directed to diverse objectives in many areas: medicine, industry, export promotion, etc. The CANDU and some other nuclear activities are at present grouped in Atomic Energy of Canada Limited (AECL). If these activities were separated, it would be easier to formulate priorities in the nuclear industry generally and in research and development. The government role in nuclear activities could then be better defined.

RENEWABLES

Renewable energy, other than hydroelectricity, may have a limited role in Canada in the near term. There may nevertheless currently be scope for non-hydro renewables (wind, biomass and photovoltaics) in remote regions, where grid connections are uneconomic. Small-scale cogeneration and renewables may also be attractive in deregulated markets where investors seek niche markets, including peak supply and provision of ancillary services and marketing "green" power to consumers who are willing to pay a premium for energy from renewable sources. Further advancement of renewable energy may require some form of support, preferably through market-based incentives consistent with reforms that are underway in the electricity market.

RESEARCH AND DEVELOPMENT

Government research and development spending has undergone substantial restructuring in response to budget cuts and changing government priorities. As a result, transparency and accountability in federal government non-nuclear research and development spending have improved. These programmes are efficiently managed and respond flexibly to government priorities, in particular to the priority now accorded to reducing greenhouse gas emissions. The level of co-ordination with industry stakeholders is high. The large reductions in research and development budgets are a cause for concern, in view of Canada's energy-intensive economy and the challenge of reducing greenhouse gas emissions. The current level of non-nuclear research support should be reconsidered and ways of increasing funding developed.

Programmes should continue to recognise the importance of projects for the medium to long term. The contraction of budgets has focused government non-nuclear research and development spending on areas where industry money can be leveraged. Private sector initiatives can improve uptake and deployment of the results of research and development programmes and the integration of government research and development with private players is laudable. But medium to long term research and development may not be of interest to industry. If funding is increased in the future, an increased share of medium to long term research and development, as well as a reconsideration of the government role in deployment, should be considered.

Government nuclear research and development spending might usefully be reviewed in a similar way as the restructured prioritisation and spending procedures in the non-nuclear area. Nuclear research and development priorities are set in a way that is different from the process used for non-nuclear programmes. With a limited total research and development budget it is axiomatic that priorities need to be assessed with considerable care. It would be helpful if the current nuclear and non-nuclear research and development budgets were prioritised and allocated to government objectives as a whole through a single process.

ENERGY RESOURCE INDUSTRIES

Canada is a major energy producer and exporter. Policy reforms have minimised government influence in resource extraction industries. Micro-economic reform to lower transport costs and to raise labour productivity will remain important.

Broader industry policies, beyond the scope of this review, will play a critically important part in maintaining the viability of Canada's energy resource industries. In relation to the coal industry, it would be desirable to create a competitive rail transport system. As a Crown corporation, the federal government has financially supported coal production by the Cape Breton Development Corporation (CBDC) for more than thirty years. In 1999, the federal government decided to privatise CBDC's operations to offer the best opportunity for long-term commercial viability. Legislation has been introduced to provide for the privatisation of CBDC's assets

RECOMMENDATIONS

The Government of Canada should:

Energy Efficiency

- ☐ Consider establishing clear objectives, possibly as quantified targets, for the contribution of end-use policies and programmes to reducing greenhouse gas emissions.

- ☐ Strengthen commitments made under voluntary agreements with industry.

- ☐ Developed closer relations between federal and provincial energy efficiency programmes, and assist provinces wishing to develop energy efficiency policies and programmes.

- ☐ Consider supplementing and integrating current sectoral programmes with economic incentives in order to maximise the uptake of efficient practices.

Energy-Environment

- ☐ Consistent with current policy, ensure that possible greenhouse gas emissions response measures are prioritised according to their cost-effectiveness for the nation as a whole.

- ☐ Build on the work of the Analysis and Modelling Group (which is being conducted as part of the Tables process) to develop a coherent package of measures to achieve Canada's greenhouse emissions target, and move quickly to reach agreement at all levels of government on a firm package of measures.

- ☐ Monitor progress towards achieving the share of Canada's greenhouse gas emissions target attributed to individual measures.

- ☐ Consider the economic implications of these measures on a regional basis in order to define regional efforts on a fair economic basis. A nation-wide emissions trading system could help equalise marginal costs and should alleviate regional differences.

- Encourage industry to develop projects using the Kyoto flexibility mechanisms, and indicatively quantify the potential contribution of these projects in achieving the Canadian greenhouse gas emissions target.

Energy Market Reform

- Analyse the benefits of deregulated electricity and gas markets as part of the wider North American energy market, as a means of encouraging the further development of freely competitive, regional electricity and gas markets to the retail level. The analysis might include the benefits of retail deregulation, corporatisation versus privatisation, and effective open market arrangements.

- Work together with provinces and industry to promote energy market reform on a regional basis and seek provincial agreement to further develop such markets. Consideration might be given to enhancing co-operation mechanisms involving policy officials and regulators, building on existing relationships, to promote interprovincial and international trade in electricity, and to provide advice and analysis of options for individual provinces on issues such as stranded costs, establishment of independent system operators and other necessary industry structure and regulatory mechanisms.

- Consider options to address the issues raised by multiple regulators setting and enforcing standards in multiple jurisdictions for the interconnected grid in an increasingly integrated North American market.

- Discuss with the provinces the role of consumer protection in deregulated markets, including requirements for the provision of adequate information to consumers to ensure informed choices are made, measures to regulate residential marketing practices, and supply in the last resort.

- Discuss with the provinces the harmonisation of domestic electricity market legislation as a means of encouraging a regional approach to investment and market development generally.

- Review the adequacy of information on emerging gas transmission capacity requirements with the objective of ensuring timely and efficient expansion of gas infrastructure by private parties.

Nuclear

- Review the management of Atomic Energy of Canada Limited, and the rationale for continuing government participation in commercial activities under AECL. A review should aim to:
  a) ensure that the Canadian nuclear industry continues to bear the full cost of its activities, unsubsidised by government;

b) take advantage of Canadian expertise by stimulating the development of profit-making private industry from activities currently within AECL; and
c) ensure that the government role in nuclear research is clearly defined.

- Move quickly to confirm and implement a policy on nuclear waste disposal, and ensure the implementation of the present policy goal of passing the full cost on to the industry.

- Ensure that decisions on the future of existing nuclear power plants take into account the greenhouse gas emissions benefits expected from their continued operation.

Renewables

- Monitor the impact of energy pricing reform in remote communities to determine its impact on the development of renewables.

- As one element in a wider strategy for market reform, seek provincial agreement for the introduction of market-based incentives in market reform policies to encourage the participation of renewables in liberalised markets.

Research and Development

- Consider giving further support for research and development related to reducing greenhouse gas emissions by reviewing the level of funding for non-nuclear energy research and development in the context of the magnitude of the task facing the Canadian Government to meet its greenhouse gas emissions target. Consideration should be given to the scope for increased support from government and private sources.

- Maintain a minimum level of sustained medium- to long-term research in the non-nuclear programme. Consideration should be given to expanding the role played by government in deployment initiatives as a means of encouraging the use of new technologies.

- Consider the benefits of setting priorities and allocating funding for nuclear and non-nuclear research and development budgets through a single process.

Coal

- Continue to work towards the sale of the assets of the Cape Breton Development Corporation and its eventual dissolution as a Crown corporation.

- Develop a means for establishing genuine competition in rail transport of bulk commodities, including coal.

FRANCE

The three main goals of French energy policy are security of energy supply; reduction of environmental impacts, especially mitigation of climate change; and low-cost energy supply. France is poor in energy resources on its national territory and depends to a large degree on energy imports. This has led to an effort to reduce dependence on energy imports and to achieve high levels of security of supply. There is a strong tradition of public service, a notion that encompasses measures taken to counteract market failures in the energy market as well as social, regional and territorial policy objectives.

Under the Kyoto Protocol and the EU burden-sharing mechanism, France is committed to stabilising its greenhouse gas emissions (six gases) at 1990 levels by 2008-2012. This target was set in recognition of the fact that France has low per-capita and per-GDP carbon emissions. The country's vast nuclear programme has contributed significantly to this result. With nuclear power providing 40 per cent of Total Primary Energy Supply and 75 to 80 per cent of electricity generation, France has the highest share of nuclear power in the world. The nuclear programme was built up essentially to address the security of supply concerns that were foremost in the national and international debate after the two oil crises. This happened long before climate change became an issue of significant order. Despite the fact that the use of nuclear was not a conscious climate policy decision, nuclear power contributed very significantly to France's favourable position with respect to carbon emissions[1].

The government expects the share of nuclear to decline in future, however, especially since its contribution to the French energy market exceeds the amount considered to be economically efficient. Because of this situation, and even more so because of the continued growth of fossil energy demand, especially in the transport sector, greenhouse gas emissions will probably have to be reduced by 10 per cent (or 16 million tonnes of carbon equivalent) in 2010. The government has just published a National Programme to Combat Climate Change, setting out a balanced range of measures. These include proposals for significant environmental (carbon) taxation: a first in France. Among the measures are also regulatory instruments and structural measures. The programme would create synergies among the individual measures and allow the stabilisation goal to be met.

Over the last 15 years, France has gradually liberalised its energy markets, beginning with deregulation and privatisation in the oil industry. France's two major oil companies, TotalFina and Elf, both privatised since 1996, merged in Spring 2000 to create the world's fourth-largest oil company. As required by the EU Electricity and Gas Directives, the country is now in the process of opening up its electricity and gas markets to competition.

1. Nuclear energy of course has environmental implications of its own; these are discussed in the Nuclear chapter in the in-depth review.

Implementation of the EU Gas Directive is under way; the government has adopted a draft bill to this effect for submission to Parliament. The degree of gas market opening proposed under the bill is close to the minimum thresholds of market opening set out in the Directive. A number of potential competitors to the state-owned natural gas supply company Gaz de France (GDF) exist, but GDF has a vastly dominant position in the downstream gas industry and enjoys a significant incumbent advantage. Discussions about partial privatisation of GDF were held but called off recently. Despite the scarcity of domestic resources, France's security of supply position in natural gas is rather favourable, due partly to a large amount of storage capacity.

Transposition of the EU Electricity Directive occurred in February 2000. The new Electricity Act liberalises the French electricity market close to the minimum thresholds required by the Directive. The state-owned French power company Electricité de France (EDF) enjoys a very dominant position and a large incumbent advantage, while being very active internationally. It is questionable whether much competition will arise under the Electricity Act. The Act contains a number of trading restrictions and does not address EDF's incumbent advantage. Taking issue with one of the trading restrictions, the European Commission launched a legal procedure against France in June 2000.

The Electricity Act also contains several public service-related provisions, and for the first time provides a legal basis for the policy of geographic uniformity of tariffs. This policy creates distortions in the energy market and it eliminates niche markets for renewables in France's overseas territories where they would be economic.

RECOMMENDATIONS

The government should:

Energy Market and Energy Policy

- Continue to reform its legislation, procedures and institutions to adapt French energy policy to the challenges of the future, namely competition, energy security and climate change. Solutions to these three issues are complex and far-reaching and require a well-informed, dispassionate public debate. The government has a key role in ensuring that the public is well informed about the implications of its choices.

- Pursue its successful strategy of clarifying and defining public service and general interest issues. Extend the strategy to encompass quantification of security and environmental externalities for France.

- Be prepared to move beyond the minimum thresholds of the EU Gas and Electricity Directives to reinforce the principle of equal treatment.

- ☐ Strive to maintain the momentum in gas market liberalisation, and to achieve transposition of the EU Gas Directive into French law close to the anticipated schedule.

- ☐ Avoid further concentration in the French energy market.

- ☐ Develop fully market-compatible measures to address climate change and energy security concerns, leaving consumers as much choice as possible in how the objectives should be reached.

- ☐ Consider carefully the impacts of geographic uniformity of tariffs. Revise the tariff system to achieve greater economic efficiency and choice for consumers and to facilitate the use of renewables, e.g. by restricting the uniform tariff to network services in existing interconnected distribution grids. Social and regional policy objectives should be pursued through specialised policy instruments.

Energy and the Environment

- ☐ Implement the measures set out in the National Programme to Combat Climate Change swiftly, and according to the anticipated schedule.

- ☐ In particular, implement the measures addressing demand and emissions growth in the transport sector without delay, as these measures will become fully effective only in the long term.

- ☐ Continually monitor the effects of various economic incentives. Adjust and tighten policies in a flexible and market-compatible way if necessary in light of the stabilisation target.

- ☐ Continue to review its energy efficiency and renewables policy with respect to all its main objectives.

- ☐ Continue and reinforce the current priority given to measures, energies and technologies that are effective and low-cost and that have the greatest potential for market uptake.

- ☐ Provide greater continuity and stability to energy efficiency and renewables policies.

- ☐ Review the biofuels programme with a view to ending tax support as soon as possible.

- ☐ Review the principle of geographic uniformity of tariffs because it distorts the market and eliminates promising niche markets for renewables in the DOM (overseas territories).

Fossil Fuels

☐ Review its public service approach to the natural gas sector in order to make it compatible with the requirements of a liberalised market and to increase efficiency and flexibility in gas supply.

☐ Ensure that more room is made available for gas supply, transmission and distribution activity by others besides GDF. Abolish GDF's exclusive gas import and export rights. Whereas GDF remains the main actor and instrument for public service in gas, the positive contributions others can bring to the consumer and to the gas supply system should not be disregarded.

☐ Give large gas users or other entities with technical and financial ability the opportunity to build and operate their own gas supply infrastructure and to buy gas via Third Party Access. Greater independence and involvement of the non-GDF-affiliated gas players should be encouraged or made possible.

☐ Be prepared to go beyond the minimum provisions of the EU Gas Directive in terms of eligibility and market opening for the benefit of large and smaller consumers. Allow extensive eligibility for cogeneration. It is important that France keep in step with the European market development, both for France's consumers and for its gas industry.

☐ Retain a role in monitoring and ensuring diversified imports in view of France's gas supply situation. Any measures to this effect should avoid rendering market access for newcomers too difficult.

☐ Make sure storage and other modulation instruments are offered on non-discriminatory and cost-reflective terms. This is vital, given their importance for gas trade and the existing concentration in storage. Part of the existing storage capacity could, however, be reserved for public service purposes like seasonal and operational balancing, safety and strategic storage, in particular for the captive market.

☐ Third Party Access rules for transport and tariffs should be made non-discriminatory and designed to enable access and trade, including secondary trade in commodity and capacity.

☐ Ensure that the regulator is totally independent of the market; the relationship of the regulator with the government should be arm's-length.

☐ Continue the promotion of upstream and downstream integration by pursuing GDF's strategy of acquiring upstream assets and by providing more freedom of action for TotalFinaElf and others in competition with GDF downstream.

Electricity

- ☐ Actively prepare the way for the French power market to adapt to developments across its borders and world-wide.
- ☐ Implement the spirit of the Electricity Directive as quickly as possible by putting in place practical arrangements to ensure that suppliers can compete with EDF on fair terms.
- ☐ Be prepared to go beyond the minimum provisions of the EU Electricity Directive in terms of eligibility and market opening for the benefit of large and smaller consumers. It is important that France keep in step with the European market development – both for France's consumers and for its power industry.
- ☐ In order to adhere to the principle of equal treatment and to avoid cross-subsidies, extend access to the competitive electricity market to all consumers as soon as possible.
- ☐ Remove uncertainty about the market among potential new entrants by defining and then clarifying by ministerial decree those areas of planning security and transparency which are still obscure.
- ☐ Work to remove practical and legal barriers to competitors who wish to supply French customers.
- ☐ Develop and implement pro-competitive mechanisms, through the regulatory structure or otherwise, to address France's public service obligations and aspirations.
- ☐ Help to remove uncertainty among French consumers and the public at large by informing them fully about the mechanisms available to protect their interests while bringing them the benefits of competition.
- ☐ Quantify energy security externalities, including those related to the electricity market. In light of the result, review the relative weight given to security of supply externalities on the one hand and competition on the other hand. Review policy measures accordingly.

Nuclear

- ☐ Maintain nuclear power as an option while continuously observing very high safety standards. Draw upon the experience of other countries concerning nuclear lifetime extensions.
- ☐ Increase efforts to expose the nuclear generating sector to a competitive environment early and directly.

- ☐ Maintain safety standards at their current high level and increase their transparency for further improvement.

- ☐ Work towards developing high-level radioactive waste management, and ensure that this activity is fully funded by nuclear waste producers.

Energy Technology and R&D

- ☐ Assess the current R&D situation in light of growing competition in the market and new challenges in the energy sector. Study the implications of these developments for the roles of different players in energy R&D and for resource allocation among them.

- ☐ Establish a three-year national research plan, identifying strategic objectives in the main areas (energy, environment, transport, information technologies). The plan should provide a comprehensive review of all efforts in the field, giving all players an overview of their national strategy and helping to avoid duplication. The research activities of the state-owned industries (EDF, GDF, Cogéma, Framatome) should also be included.

- ☐ Strengthen the co-ordination among the Ministries of Higher Education and Research, Industry, Environment and Transport in defining and implementing this plan.

- ☐ Evaluate periodically and systematically the efficiency and effectiveness of government research programmes using independent experts.

LUXEMBOURG

Luxembourg is the smallest IEA country, but its population of 430,000 inhabitants is the richest of all IEA countries. Energy consumption per inhabitant is high because of the country's iron and steel industry, the large amount of transport fuel sales and the overall wealth of the country. Domestic energy resources are limited to renewable energies. Therefore Luxembourg has the highest dependence on imported energy (more than 99% of total energy in 1998) of all IEA countries. Also, because of its small size and lack of indigenous sources, Luxembourg's energy market is greatly influenced by the energy policies and energy markets in surrounding countries.

Since the last in-depth review, progress has been achieved in Luxembourg's energy policies. The government rightly regards market liberalisation in the whole of Europe as an opportunity for enterprises and domestic consumers in Luxembourg, as it will allow them to benefit from reduced energy prices.

Although decreasing, state and municipal ownership in energy companies remains significant in Luxembourg. According to the government, there is no interference in companies' strategic decisions. Some municipalities are directly engaged in electricity and natural gas distribution activities. To ensure that all companies compete on a level playing field, as a first step, these activities should be separated from municipal/communal administration.

Energy taxes are low in Luxembourg, particularly on automotive fuels. Low automotive fuel prices have induced foreign drivers to refuel in Luxembourg. Better internalisation of the full cost of using energy would reduce this market distortion. It is therefore welcome that the government plans to introduce an energy tax.

95% of the electricity consumed in Luxembourg is imported. However, the commissioning of a combined cycle gas turbine in 2001 will reduce electricity imports. In May 2000, Parliament voted a law to implement the EU Directive on the Internal Electricity Market. Owing to the small size of Luxembourg, eligible consumers will have a large choice among suppliers in and outside the country. Therefore, the proper functioning of competition will also depend on regulations outside the country, e.g. for use of the grid.

Electricity generation from renewable energy and co-generation has expanded rapidly because of the generous buy-back tariffs and direct subsidies. The government should ensure that support for renewable energy does not put too heavy a burden on electricity consumers. This could be achieved by improving the cost-effectiveness of support schemes. The best way to ensure that energy production from renewable forms of energy is sustainable in the long term is to ensure that their cost decreases to a level which makes them competitive. The government should also consider phasing out subsidies for co-generation, as this technology is now mature.

Luxembourg is totally dependent on natural gas imports, which have increased rapidly. However, imports have been diversified, increasing Luxembourg's security of energy supply. The gas pipeline being built from Germany, in particular, will further diversify supplies. Luxembourg expects to pass a law implementing the European Directive on the Internal Natural Gas Market before the end of 2000. Large consumers are expected to benefit from this liberalisation.

Luxembourg is totally dependent on oil products imports. Its oil sector is strictly retail. The government sets price ceilings on the most important oil products to avoid inflation. This system may also prevent abuses of dominant position if competition does not work properly. Since effective competition encourages companies to decrease costs of supply, allowing them to reduce sale prices, the government should rely on market forces to keep oil product prices low.

Energy efficiency policy in Luxembourg received a welcome boost in 1993, when a new framework law on energy efficiency was adopted. Several Grand Ducal regulations (decrees) have been issued to implement this law and the government needs to start assessing their cost-effectiveness. Implementation of the energy tax will also encourage energy savings.

The restructuring of the iron and steel industry led to a sharp reduction in CO_2 emissions and other pollutant emissions in Luxembourg. However, after the end of this restructuring process, CO_2 emissions are expected to increase. Therefore, the Kyoto target of a 28% reduction in greenhouse gas (GHG) emissions will be difficult to reach. The 1998 National Plan, which rightly recommends adopting a programme to meet this target, needs to be implemented with effective measures.

The *Agence de l'Énergie* has done valuable work in advising municipalities on energy efficiency and renewable energy and through studies on the feasibility of projects. Its activity should therefore be encouraged.

RECOMMENDATIONS

The Government of Luxembourg should:

Energy Policy and Market Trends

- ☐ Continue to introduce competition in the gas and electricity sectors. Set up a regulatory body with responsibility for both electricity and gas.

- ☐ Ensure that entities with government or municipal shareholding are free in their strategic decision-making and daily management to allow them to compete on a level playing field.

- ☐ Continue to work towards close and effective co-operation among all the ministries involved in energy policy.

- ☐ Continue to co-operate with neighbouring countries on energy issues, e.g. electricity and natural gas liberalisation and inter-state transport.

- ☐ Address automotive tax distortion by implementing the proposed measure in the National Plan for Sustainable Development to levy an energy tax to better reflect the cost of energy use.

Energy Efficiency and Environment Policy

- ☐ Assess the cost-benefits of support for energy efficiency measures. In particular, the government should put in place a framework to measure the outcome of the programme to improve energy efficiency in existing buildings.

- ☐ Encourage the *Fédération des Industriels Luxembourgeois* (FEDIL) to continue the voluntary agreement with industry and to extend the agreement to other economic sectors and improve the monitoring system.

- ☐ Develop and implement a comprehensive climate change mitigation plan with concrete measures in order to start getting current GHG levels on track towards meeting Kyoto commitments.

- ☐ Continue to seek solutions at a regional level, i.e. with neighbouring countries, to reduce energy consumption in the transport sector.

Oil

- ☐ Address automotive fuel tax distortion by better internalising the external cost of using oil products in taxes.

- ☐ Remove price ceilings on gasoline, diesel, heating oil and LPG and ensure that competition authorities have enough power to track down those guilty of anti-competitive practices.

Natural Gas

- ☐ Implement competition in the gas market as soon as possible.

- ☐ Maintain an arm's-length relationship with companies having public ownership.

- ☐ When introducing competition, corporatise the small municipal entities and require the separation of accounts for all activities of gas suppliers.

- ☐ Set up a regulator with adequate powers, duties and resources to supervise and control the prices charged to final consumers and to deal with customers' complaints.

- ☐ Co-operate with neighbouring countries for the introduction of effective competition in the natural gas sector at regional level.

Electricity and Renewable Energy

Electricity

- ☐ Maintain an arm's-length relationship with the companies having state ownership in the electricity sector so that they have the same freedom to operate in the market as any other businesses.

- ☐ Corporatise the small municipal entities and require the separation of accounts for all their activities.

- ☐ Co-operate with neighbouring countries for the introduction of effective competition in the electricity sector at regional level.

- ☐ Ensure that the regulator is given adequate powers, duties and resources to supervise and control the prices charged to final consumers, to deal with customers' complaints and to ensure that there is no discrimination between the users of the grid.

- ☐ Encourage companies to explore further the cost-benefits of closer co-operation between the two grids.

Renewable Sources of Energy

- ☐ Ensure that the measures used to promote renewable energies put downward pressure on their costs by introducing competition among them and ensure that these measures do not put too heavy a burden on final consumers.

- ☐ Encourage the activities of the *Agence de l'Énergie*, i.e. carrying out studies on renewable sources and energy efficiency and advising municipalities.

Co-generation

- ☐ Consider phasing out subsidies to co-generation, as this is a mature technology.

- ☐ Give adequate powers to a competent body to supervise and control heating prices.

PORTUGAL

Energy consumption in Portugal is expected to continue growing with GDP. Portugal has a low energy production and is increasingly dependent on imported energy. Portuguese energy policy has aimed at liberalizing energy markets, ensuring security of energy supply, improving energy efficiency and mitigating environmental problems. Consistent with these objectives, Portugal has increased its effort to diversify energy sources, in particular through the introduction of natural gas, and to improve energy efficiency with the support of the European Union's "Community Support Framework".

Since the last review, the government has taken measures to prepare an environment for competition in the electricity sector and has continued to liberalise the oil sector in line with the IEA's Shared Goals. In addition, Portugal's energy companies have been restructured and the government has begun their privatisation.

The government has started to privatise Electricidade de Portugal (EDP) and Petrogal, which have dominant positions in the electricity and oil sectors. In 1999, Gás de Portugal (GDP), which retained a monopoly position in imports and transport through its subsidiary Transgás and a dominant position in distribution, remained fully owned by the state. In April 1999, the government set up a holding company called Petróleos e Gás de Portugal, SGPS, S.A. (GALP), including GDP and Petrogal, the national oil company. GALP is responsible for the operation and management of the Portuguese oil and gas industries. The aim is to gradually privatise GALP and create an enterprise large enough to compete in the Iberian market.

An important policy objective is to avoid abuse by these companies of their dominant position in their respective markets. In this regard, the development of effective competition in the Iberian electricity and gas sectors has become essential.

Portugal has taken a cautious approach towards liberalisation in the electricity sector. The electricity law of 1995 divided the electricity market into a competitive segment and a centralised (non-competitive) segment. In 1995, an independent electricity regulator, the Entidade Reguladora do Sector Eléctrico (ERSE), was established with extensive powers and in 1999, the electricity law was adapted to the EU directive on electricity. However, in 1999, the competitive segment of the electricity market was not functioning adequately. Therefore, further measures are needed to implement effective competition.

The successful introduction of natural gas has been a key factor in the diversification of Portugal's energy sources and mitigation of environmental problems. Gas was first used in electricity generation, allowing electricity to be supplied at a competitive price. Gas consumption has expanded rapidly since 1997: the construction of pipelines and the conversion of facilities to adapt to natural gas have been supported by funds from the 1994 Energy Programme granted by the EU and the Portuguese state. Security of gas supply remains an important issue, since Portugal will continue to depend mainly on a single gas supplier.

Because Portugal is an emergent gas market, European legislation permits the introduction of competition to be delayed for ten years after the beginning of gas supplies. Therefore, the government obtained a derogation from the EU directive which will allow Portugal to delay the introduction of competition in the gas market until 2008. In January 1999, the government and the major energy consumers agreed to establish a regulator for the gas market. A clear schedule for the implementation of competition and an early decision on its modalities would allow suppliers and consumers to prepare for the liberalised gas market.

In the early 1990s, the Portuguese oil sector experienced major changes. Oil consumption was growing quickly and the government introduced competition in a short time frame in parallel with the partial privatisation of Petrogal. Price ceilings, set by the government to protect consumers from abuses, have been progressively removed but have been maintained on gasoline and automotive diesel. Since competition has now developed for these two products, there is no economic rationale to maintain price ceilings.

Improving energy efficiency has been an important policy objective in order to reduce the sharp growth of energy demand, lower the increase in greenhouse gas emissions and help Portuguese industries to be competitive. However, energy-related CO_2 emissions have increased rapidly and are expected to continue growing sharply. To achieve the Kyoto target of limiting the increase to 27% between 1990 and 2008-2010, further efforts may be needed.

All of Portugal's own energy production is from renewable energy. The government has promoted renewable sources through funding from the 1994 Energy Programme and a premium on electricity purchases from renewable sources. The government does not favour any specific fuel and grants subsidies only to economically viable projects. As the number of projects is increasing, the government should select the most cost-efficient ones and promote cost reductions.

Public funding for energy R&D decreased substantially between 1990 and 1997. It increased in 1998 and 1999 but was still one of the smallest budgets of IEA countries with regard to GDP. The government rightly plans to reform public R&D to improve its efficiency. In its reform, the government needs to sharpen the focus of public research in energy, to assess the results of R&D programmes and to strengthen co-operation with industry in order to achieve better market deployment of new technologies.

RECOMMENDATIONS

The Portuguese Government should:

Energy Policy and Market Trends

- ☐ Take further measures to stimulate competition in the energy sector.
- ☐ Continue to work for the development of effective, competitive Iberian natural gas and electricity sectors.
- ☐ Establish clear arm's-length relations between the state and companies with state ownership.
- ☐ Reform the tax system to better internalise external costs of using energy.
- ☐ Enhance co-ordination of energy policy measures between the different ministries and appropriate organisations to take better account of energy in other policies and increase efficiency.

Energy Efficiency and Environment Policy

- ☐ Release, as soon as practicable, its report evaluating GHG emission trends so that a comprehensive assessment can be made of how much Portugal must reduce its emissions to meet its climate change commitments under the Kyoto Protocol.
- ☐ Revive its efforts to develop and implement a comprehensive climate change mitigation plan in order to start getting current GHG levels on track to meeting Kyoto commitments.
- ☐ Set up new programmes for energy efficiency in the different sectors, taking into account the results of the assessments of the previous programmes to focus on the most cost-effective measures. Ensure that these programmes are effectively funded.
- ☐ Increase information to energy consumers on energy efficiency measures. Focus on measures to improve energy efficiency in small industries, such as providing information and expertise.
- ☐ Carefully assess the results of the energy audits in industry to improve the effectiveness of energy efficiency measures in this sector.
- ☐ Continue to increase investment in railways and to develop modern public transport in the major towns.

- ☐ Ensure maximum compliance with EU directives on labelling. Ensure that the Regulation on the Energy Systems for Air Conditioning of Buildings is periodically revised to adapt to new technologies. Contribute to the elaboration of EU regulations on labelling and efficiency standards for cooling appliances.

- ☐ Ensure that building codes are periodically revised to take into account technical improvements. Ensure that these codes are effectively implemented and that their implementation is effectively monitored at local level.

Oil

- ☐ Continue to take active steps to enhance competition in the oil sector.

- ☐ Remove remaining price ceilings on oil products as soon as possible.

Natural Gas

- ☐ Continue to favour diversity of gas supplies.

- ☐ Ensure that regulations providing for gas security of supply, in particular gas storage requirements, will be adapted to the future competitive gas market.

- ☐ Phase out subsidies to gas infrastructure when the gas market is mature to allow gas to compete on a level playing field with the other fuels.

- ☐ Set a clear schedule for the introduction of competition in the gas market and take an early decision on its modalities so that suppliers and consumers have a firm basis to adapt to the new market.

- ☐ Ensure effective unbundling between gas import facilities, transmission, distribution, supply and non-gas activities to create a level playing field.

- ☐ Introduce regulated third party access to prevent any discrimination between users of gas infrastructure.

- ☐ Set up an independent regulator in charge of preparing for and ensuring fair competition, e.g. setting tariffs and dealing with consumers' complaints.

Electricity

- ☐ Give public support to competition in the electricity sector through the Expansion Plans prepared by the General Department of Energy, in particular by encouraging the competitive part of the independent system to develop.

- ☐ Consider replacing power purchase agreements between generators in the Public Electricity System and Rede Eléctrica Nacional by a more competitive system to better pass on efficiency gains to end users.

- ☐ Ensure that generators in the electricity sector benefit from the same purchase conditions for natural gas. Joint ventures in electricity generation involving EDP and GDP should not reinforce EDP's dominant situation in the electricity market.

- ☐ Clearly determine the available capacity for international electricity trading and the terms and conditions for the use of interconnections.

- ☐ Encourage the development of tariffs for transmission and in particular cross-border tariffs allowing for effective trade and competition. Take measures to clarify the rules for handling of possible bottlenecks and reinforcement of the grid when new generation/consumption or trading requires it.

- ☐ Take into account the importance of small and medium enterprises in Portugal's economy, allowing them to form consortia in order to qualify as eligible consumers.

- ☐ Relax the limitations on the distributors for buying electricity in the Independent Electricity System.

- ☐ Remove the limitations on co-generators wanting to sell electricity directly to consumers.

- ☐ Safeguard the independence of the regulator and ensure that the resolution of disputes between consumers and suppliers is under its control.

- ☐ Encourage the regulator to ensure the effective independence of both the System Operator and the Market Operator to avoid discrimination between the users of the grid.

- ☐ Encourage the regulator to set cost-reflective prices for end users to ensure that there are no cross-subsidies in favour of eligible consumers.

Renewable Energy Sources

- ☐ Ensure that the promotion of renewable sources, including through a new Energy Programme, encourages a decrease in their costs, e.g. by introducing competition among them.

- ☐ Continue to seek the most cost-effective ways to promote renewable sources, including biomass and in the domestic sector.

Energy Technology, Research and Development

- ☐ Develop a national energy R&D strategy that is coherent with Portuguese energy policy and that encourages private companies to undertake R&D.

- ☐ Encourage public research institutes, and in particular the Instituto Nacional de Engenharia e Tecnologia Industrial, to sharpen the focus of public research, to assess the results of R&D programmes and to strengthen co-operation with industry to better secure market deployment of new technologies.

- ☐ Continue to ensure effective participation in international energy R&D programmes focusing on those which are of major national interest.

SWEDEN

Sweden has in place strong, market-based policies in some areas of the energy sector. Market-oriented policies include:

- The successful development of an international market in electricity.
- Co-operation in the Baltic Sea region on energy, climate policy and wider trade issues.
- Close consultation of government with industry, and a high level of industry awareness and voluntary activity.
- Tax measures to encourage, but not micro-manage, the development of the energy sector in an economically efficient and environmentally sustainable way. Even so, the structure of the system could be improved.

But there is a high level of government intervention in other areas. Energy policy in Sweden is influenced by several key decisions:

- The decision to phase out nuclear power.
- The commitment to reduce greenhouse gas emissions in line with the Kyoto Protocol.
- Limits to the further development of hydro resources.
- The aim to use renewables and energy efficiency as the principal means of replacing lost nuclear capacity.
- Requirement for a certain, but unquantified, degree of self-sufficiency in power generation.

Difficulties in achieving all these elements of energy policy have, together with conflicting views on the role of natural gas, given rise to uncertainty about the future direction of Swedish energy policy, and a degree of political intervention in the energy market. Mistakes could be costly to rectify. This could happen if large-scale applications of biofuels and renewables do not become economically competitive, or if the phasing-out of nuclear power generation is pushed too fast and replacement sources of electricity are insecure or too expensive.

Marked differences of view exist between the government and important areas of the industry. Low electricity prices following deregulation of the electricity market have reduced interest in investment in new generating capacity. There is also a marked difference of view between the government and industry on the future of the energy sector that may give rise to uncertainty affecting investment in the sector. Industry leaders believe that it will not be possible to make renewable forms of energy competitive for some time and are planning on the basis of the existing fuel mix. Moreover, they consider that market pressures on nuclear will eventually lead to the closure of reactors, starting with the least competitive. Industry leaders also believe that other energy sources, including imported electricity, will continue to be cheap and will maintain Sweden's energy security and overall competitiveness. Industry considers government ambitions for renewables may be unachievable except in the long term, and that government measures may result in distortion of the electricity market.

Energy policy formulation is complex. Certain inconsistencies reflect the different origins of policy initiatives, and need to be rationalised. Government consideration of the report of the Climate Commission may offer an opportunity to review government energy goals and priorities and, in consultation with industry and other stakeholders, to develop a set of achievable and cost-effective policy priorities.

As a result of successful policies, electricity prices are low and electricity is of fundamental importance to the economy. Swedish electricity prices are low, and the price of electricity is one source of competitive advantage for Sweden. On the other hand, the intensity of electricity use in Sweden is among the highest in the world (double the IEA Europe average and slightly higher than in the US). This means that the price of electricity is disproportionately important for the Swedish economy. For these reasons, it is an explicit and essential priority of Swedish energy policy that electricity prices must remain at competitive levels, even if the fuel mix changes.

Energy taxation is a central policy instrument in Sweden: the tax regime needs to be simplified, the balance between revenue, environmental and energy policy goals needs to be clarified, and the tax regime kept stable over time. An energy tax, a carbon tax and a sulphur tax apply to the energy sector, as well as a number of other minor taxes. The tax system is complex and has undergone many revisions over time. Achieving a balance between revenue, environmental and specific energy policy goals should be one of the guiding principles in the review currently being conducted of the energy tax system. The present nuclear tax is not directly related to nuclear policy goals and impedes competition in the international electricity market. It should preferably be abolished, but it could be redesigned as part of a market-based package of measures to reduce the cost of phasing out nuclear.

Taxes and environmental objectives need to be harmonised and the unintended effects of taxes addressed. Energy taxes require review in relation to their effects on fuel choice, and their impact on trade in electricity. Harmonisation of taxation is needed in the electricity market, including a clear choice between production or consumption taxes.

Harmonisation of environmental objectives, ideally in the wider EU context, would be desirable as a starting point to rationalising the taxation system. Pending this development, consideration needs to be given to particular aspects of the Nordic electricity market. The approach to coal-based electricity production (principally from Denmark, but also from other countries) needs to be rationalised to avoid the clear inconsistency of developing carbon-free fuels domestically while importing low-cost coal-fired electricity.

Natural gas could emerge as a cost-effective option, but the investment climate could be improved. Energy policy should be based more broadly on market principles. The long-term objective of moving the energy sector to a renewables base is not questioned, provided electricity prices remain competitive. Natural gas could be a competitive alternative to nuclear, without the perceived safety and environmental problems of nuclear, but avoiding the high cost of a swift transition to renewables at their current state of development. In the case of Sweden, a move to gas would, however, mean accepting a higher level of carbon dioxide emissions.

Achieving a balance between environmental and economic goals is complicated by the policy of phasing out nuclear. The Government of Sweden could take a more positive position on the development of gas. Measures underway, or which might be considered, include:

- Implementing, as planned, the EU Gas Directive with a view to opening the market as soon as possible.
- Addressing the influence of major suppliers in the gas and electricity markets on the development of the gas market.
- Establishing a stable tax regime.
- Facilitating access to the system network and the development of gas infrastructure by interested parties.

Rapidly phasing out nuclear will make it harder to achieve Sweden's greenhouse gas emissions target. The policies and measures adopted after consideration of the Climate Commission report should be cost-effective and realistic. If nuclear continues to be phased out, it is unlikely that renewables will be sufficiently developed in time to play a significant role in achieving Sweden's greenhouse gas emissions target. More extensive use of natural gas would raise the level of emissions. Current policy requires that the pace and manner of phasing out nuclear and introducing renewables should not damage Sweden's international competitiveness. But unreasonable expectations about the use of renewables to achieve the Kyoto target could lead to premature introduction of alternatives to nuclear, and jeopardise Sweden's competitiveness. It is essential that policies and measures are cost-effective, balancing economic and environmental goals in a realistic manner.

In Sweden, as in most IEA countries, market principles should encourage the use of the Kyoto flexible mechanisms. Sweden has undertaken important studies of the potential for the flexible mechanisms such as in its Baltic Sea region pilot programme. Baltic Sea regional co-operation is an important example to other IEA countries of how governments can develop the Kyoto flexible mechanisms. This should be further developed as a central goal of energy-environment policy.

Although Sweden has considered the use of a wide range of climate policies, little consideration has been given to the potential role of sinks. This is an area where studies might be usefully undertaken.

As in other IEA countries, progress in improving efficiency in transport is difficult. But it will become particularly important for energy-environment policy in Sweden, since opportunities for progress in reducing emissions in other sectors are limited. Development of alternative transport fuels to replace oil is a priority, but closer attention should be given to the commercial prospects of ethanol. Refiners are neutral on the issue because of their limited financial involvement to date. It is nevertheless important that they be involved from the outset if there is to be any prospect of commercial development of alternative fuels. Oil is also used in heating, as well as transport, and it may be possible to cost-effectively reduce oil consumption in that sector for security and environmental reasons.

There is a need to clarify a policy for nuclear. Current policy on nuclear energy may impede developing a policy framework based on international markets and cost-effectiveness. Nuclear policy needs to be clarified. The electricity supply industry expects major reductions in nuclear capacity over the next 20 years because of competitive pressures. The government should consider allowing existing nuclear to be phased out on the basis of the economic life of existing reactors.

Even now, the closure of reactors can only be required by the government under certain conditions, including, for example, that closures do not damage industrial competitiveness. How the criteria are to be applied is not yet established. A good start has been made by commissioning independent consultants to evaluate Barsebäck 2 reactor against the statutory conditions. It is important that objective criteria be set out as well as a process established which is acceptable to all the parties for determining when the criteria are met. The criteria and the procedure for implementing Parliament's decision should be as transparent as possible, and allow independent organisations to study and analyse all relevant information. It would also be desirable to undertake a study, in consultation with industry, on the development of renewables. This study would provide an indication of the time-scale in which renewables might become competitive with other forms of energy and on a scale sufficient to replace existing nuclear reactors.

Existing nuclear capacity should be used productively pending any definitive policy on its future. Sufficient level of support must be maintained to ensure the continuing safe operation of reactors, the disposal of waste, and the attractiveness of the industry for competent new personnel.

Energy efficiency policy evaluation needs to be improved. It is planned that future reactor closures will be compensated, in part, by decreased electricity consumption. However, given the healthy growth of the Swedish economy in recent years and the optimistic outlook for future growth, chances for reducing electricity consumption seem very limited in the short to medium term. The principal means of reducing electricity consumption is to promote the replacement of electrical space heating. Increased taxation of electricity may offer a more efficient and effective means of reducing electricity consumption, but the task is huge and difficult. Taxes on electricity are already quite high, and have been raised rapidly during the last couple of years.

The evaluation of efficiency programmes is at present inadequate. Current qualitative evaluation procedures need to be improved as a basis both for any future decision on nuclear power and for formulating future energy efficiency policies. Little has been achieved in improving energy efficiency since the late 1980s. Sustained improvements in energy efficiency over a number of years would need to be demonstrated to justify closure of nuclear plants. There is also a need to look for further effective energy efficiency measures in the transport sector since this is the main sector contributing to greenhouse gas emissions.

Regulation and performance of the electricity market require attention on some details. The Nordic electricity market and domestic liberalisation have worked well. The Nord Pool has become a leading example internationally of how to design a competitive electricity market. There is room for improvement in the following areas, discussed in detail in the report:

- Harmonising cross-border transmission tariffs.
- Addressing domestic transmission tariff issues, including congestion.
- Generation capacity constraints.
- Ownership issues in the gas and electricity markets.
- Independence of regulation.

RECOMMENDATIONS

The Government of Sweden should:

General Energy Policy

- ☐ Take the opportunity of the debate on the Climate Commission report to review energy policy goals, in consultation with industry and other stakeholders. The aim should be to formulate a set of consistent, achievable and cost-effective priorities based on market principles, and to establish a stable policy environment.

- Improve the structure of the energy tax regime to reflect more clearly the balance between energy policy, environmental and general revenue goals.

- Simplify and maintain stability in the energy tax regime to ensure investors are able to plan for the long term in a certain tax environment.

- Negotiate harmonised energy taxation in the Nordic region to remove distortionary effects on energy trade.

- Evaluate the cost of unintentional effects of the taxation system.

- Review the effects of the nuclear production tax, and consider the possibility of abolishing the tax as part of a tax reform.

- Consider strengthening the independence of energy sector regulators.

- Review the influence of ownership on the development of competition in the energy sector.

Environment

- Move quickly to settle a package of cost-effective policies and measures to meet Sweden's greenhouse gas target.

- Integrate environmental concerns (local, regional and global) into energy policies, while also maintaining the objectives of security of supply and competitiveness.

- Continue the pilot development of the Kyoto flexible mechanisms in the Baltic Sea region in anticipation of international agreement on the implementation of the mechanisms.

- Take into account the role of sinks as a potentially important measure for use by Sweden.

Efficiency

- Clarify existing qualitative goals for efficiency improvement programmes to ensure an objective assessment can be made of their cost-effectiveness and, in particular, the contribution energy efficiency programmes may make to offsetting any further reductions in nuclear capacity.

- Consider increasing taxes on household electricity consumption as an alternative to promoting the expansion of district heating as a means of reducing electricity consumption.

- Harmonise taxation of heat and electricity production from combined heat and power plants.

Electricity

- ☐ Consider the influence of the present major players in the gas and electricity markets on the development of gas-fired electricity generation and ensure that there is no discrimination in the gas market against gas-fired energy production.
- ☐ Review transmission congestion and pricing mechanisms to identify potential improvements such as pricing methods that better reflect costs and enhanced co-ordination between Nordic system operators in the management of reserves.
- ☐ Introduce, as planned, a scheme to support market entry of renewables that does not distort competition.
- ☐ In the context of the "Florence process", consider reforms to the cross-border tariff system to facilitate trade with EU countries outside the Nordic countries.
- ☐ In the context of the ongoing review of distribution tariffs, identify options to provide stronger incentives for efficiency in distribution and to ensure that distribution tariffs are cost-reflective and do not cross-subsidise supply activities.

Nuclear

- ☐ Assess the economic advantages of allowing existing nuclear to be phased out on the basis of the economic life of existing reactors.
- ☐ Ensure full transparency and independence of the evaluation to be made to determine when the criteria established by the Parliament for the closure of reactors have been met.
- ☐ Pending any further government decisions on nuclear reactor closures, ensure the continuing safe and economic operation of existing reactors.
- ☐ Continue progress towards the selection and construction of a final repository for high-level wastes; review the adequacy of the present low- and medium-level waste repositories and facilitate their expansion, if necessary for decommissioning waste.

Gas

- ☐ Further develop the policy framework for the use of natural gas, including the following elements:
  - ☐ Implementing, as planned, the EU Gas Directive with a view to opening the market as soon as possible.
  - ☐ Addressing the influence of the present major players in the gas and electricity markets on the development of the gas market.
  - ☐ Establishing a stable tax regime.
  - ☐ Adopting measures to facilitate access to the system network and the development of gas infrastructure by interested parties.

- Take into account the supply security implications for Sweden if any proposal for a second gas pipeline is submitted for approval.

Renewables

- Keep government support for renewables under continuous review, with the objective of ensuring that satisfactory progress is being made towards the goal of competitiveness with other fuels.

- Ensure that policy on the use of biofuels does not give rise to support for indigenous fuels principally for reasons of supply security, or for social, regional or industry policy purposes.

- Continuously update assessments of the capacity of forest-based industries to supply sufficient biomass at acceptable cost to meet the requirements for biomass in electricity generation.

Research and Development

- Further streamline the administration of energy research and development; and ensure that the goals of programmes and criteria for project selection are determined by government energy policy objectives, and evaluated against these objectives.

- Review the research and development programme to ensure that projects undertaken are justified on grounds of their outcomes, and that they give rise to cost-effective energy technologies within targeted time periods; work closely with industry programmes to ensure harmony of objectives and complementarity of outcomes.

THE NETHERLANDS

In the Netherlands, the potential tension between the search for low energy prices through competition and environmental imperatives is perhaps more visible than in any other IEA country. Dutch voters are very environmentally minded, and the government reflects their concern in setting very ambitious targets for carbon dioxide emissions, energy efficiency improvements and the share of renewables in the energy mix. The country aims at increasing the share of renewables from 1 per cent in 1995 to 5 per cent in 2010 and 10 per cent in 2020.

Surveys show that a sufficiently large part of the Dutch population would agree to pay extra for clean and renewable energy to meet the targets without additional compulsory measures on the demand side. For this reason, the government has abandoned the idea of a mandatory green certificates scheme that was under discussion during the last IEA in-depth review. The challenge the government must now overcome to meet its renewables target lies on the supply side; it must raise the acceptance of renewable installations in a small, densely populated country. Some of the solutions carry significantly higher cost and are controversial, such as the off-shore wind parks now planned in some locations.

To meet its climate change commitments, the country must reduce its greenhouse gas emissions from 1990 levels by 6 per cent by the end of the first budget period in 2008-2012. This means a reduction of 50 million tonnes of carbon dioxide equivalent, half of it at home and the other half abroad, using flexibility mechanisms in the Kyoto Protocol. The government has put together a programme that can achieve this, as well as a back-up plan if the target is not reached and a long-term plan that maps out the policy beyond 2010. The basic climate change programme and the back-up plan are very well researched. They contain cost-effective and realistic measures. The government had the foresight to rule out some highly cost-effective measures that are politically unacceptable, such as the more radical approaches to bring about modal shift in the transport sector. The long-term plan contains innovative but economic ways to reduce greenhouse gas emissions.

But the Netherlands is also very market-oriented. Competition is being introduced in both the power and the gas industries. In both industries full retail competition was initially to be introduced in 2007, but the deadline has recently been moved up to 2004, much earlier than required under the EU Directives.

The vast Groningen field is one of the biggest gas fields in IEA Europe. Through its unique capability to act as a swing supplier, this field has importance far beyond Dutch borders. To preserve this field, the government has developed what has become known as the small fields policy. One challenge for the government is to preserve the small fields policy in the potentially highly competitive new gas market.

Pressure at the Groningen field is now declining, and the Netherlands has begun importing gas from Russia. This may raise concern about security of supply, an issue the government well recognises. Security of supply policy has become more flexible in recent years. The requirement for the Dutch gas industry to demonstrate 25 years of indigenous supplies for the domestic market is no longer an obligatory condition for the granting of gas export licences. The government is striving for a European-wide solution to gas security concerns, a strategy that seems well adapted to the development of a competitive European gas market.

Competition was introduced to the Dutch power market in 1998. With the necessary institutions and secondary legislation now in place, the market has become very competitive. There is vigorous electricity trade as well as foreign direct investment. Three of the country's four large generators have been sold to foreign investors. Despite the existence of overcapacity in the Dutch power generation market, the demand for power imports is such that interconnector capacity is vastly oversubscribed. Efficient rules for the allocation of interconnector capacity need to be established in co-operation with the Netherlands' European neighbours. Recent developments show encouraging signs in the right direction.

RECOMMENDATIONS

The government should:

Energy Market and Energy Policy

- ☐ Maintain the current balance between economic efficiency goals and environmental considerations.
- ☐ Proceed with market opening in the electricity and gas markets as swiftly as possible.
- ☐ Continue the current approach to tax reform, especially the redistribution of revenues to taxpayers if further tax increases prove necessary to achieve both economic and environmental objectives.
- ☐ Decide whether there should be any limits to energy tax increases, and if so, what they should be.
- ☐ Decide how much diversification in the power industry is necessary, taking into account that the market consists of the entire European Union. Monitor the market.

Energy and the Environment

- ☐ Continue to monitor energy market and emissions trends closely and continue to respond to them in a flexible way.
- ☐ Continue to adjust policies to what is realistically feasible and continue to shift to low-cost, politically acceptable measures as much as possible. Use public awareness campaigns to highlight difficult choices.
- ☐ Speed up the development and introduction of the voluntary green certificates trading scheme. Such schemes require much attention to detail and consultation with participants. More concrete rules must be proposed soon if the deadline for start-up in 2001 is to be met.
- ☐ Make use by all possible means of consumers' and voters' willingness to pay for environmentally benign renewable energy sources, while ensuring efficient, low-cost supply of these energies and addressing acceptance problems.

Fossil Fuels

- ☐ Maintain its policy of liberalising the gas market in pragmatic steps while trying to retain the benefits of the previous gas policy.
- ☐ Ensure that the safeguard provisions for non-discrimination contained in the Netherlands Gas Act are fully implemented and supported by adequate resources.
- ☐ Review and reconsider the terms for exploration of small fields with a view to improving the conditions for those activities and stimulating the continued development of small fields.
- ☐ Pursue the current adjustments in mining law and policy. Monitor future exploration and development activities.
- ☐ Encourage gas companies to continue their rapid adaptation to competition. Work towards eliminating the last remaining inefficiencies in gas price structures, especially those relating to capacity charges and tariffs for smaller retail customers.
- ☐ Work towards a European solution for long-term security of supply.

Electricity

- ☐ Ensure that no further concentration occurs in the generation market.

- Closely monitor competition in the generation market, especially with a view towards identifying, and if necessary limiting, the potential incumbent's advantage that the four centralised generators may enjoy through system overcapacity and their privileged access to interconnector capacity.

- Carefully weigh the costs and benefits of CHP expansion. Make the costs as transparent as the benefits.

- Ensure that transmission grid development allows a fully open market, in particular with respect to cross-border trade. Continue to strive for a European solution. Continue to encourage possible solutions with adjacent countries and monitor the effectiveness of TenneT and the transmission tariff in bringing about appropriate investments and technical improvements.

- Clarify the criteria used for attributing interconnector capacity and make them available to the interested public. Strive to develop and phase in a market-based allocation mechanism as soon as possible.

Energy Technology and R&D

- Maintain its research and development policy well in line with its overall energy policy objectives.

- Continue to allocate efforts and funds in a balanced way among popular and less popular but potentially promising technology options.

- Continue the excellent co-operation between public and private sector research institutions.

STANDARD REVIEWS

Austria

Denmark

Germany

Greece

The United Kingdom

The United States

AUSTRIA

GENERAL OVERVIEW

Austria is a federal country with nine provinces (Länder), which, under the Austrian Constitution, have considerable powers in energy policy, especially with respect to energy efficiency. Austria became a member of the European Union in 1995, and following its accession and the ensuing adaptation process, much of its energy policy-making is thus influenced by the super-national and the supra-national level.

Throughout the second half of the 20th century, Austria has had a very consensus-oriented approach to economic policy, which found one of its expressions in the "social partnership" system, whereby employers' and workers' organisations strive to reach consensus on economic issues. Following general elections in autumn 1999, a centre-right government was formed in early 2000 for the first time after several decades of rule by a great coalition uniting the country's two major political groupings.

The main policy objectives of Austrian energy policy continue to be the ones set out in the 1996 Energy Report of the Austrian Republic:

- Security of energy supply.
- Cost-efficient energy supply.
- Environmental protection.
- Social acceptability of energy supply.

ELECTRICITY AND RENEWABLES

The Austrian power industry consists of one large production, wholesale and transmission company, Verbundgesellschaft, nine large provincial power utilities, and a number of smaller, local, municipal or private generators/suppliers. The nine regional utilities operate in the nine provinces, but some of them have supply territories that include parts of several contiguous provinces. They generate their own power, but they also buy power from the Verbundgesellschaft for distribution and retailing to ultimate consumers. In the past, the Verbundgesellschaft held a monopoly on electricity trade with foreign suppliers.

Austria's electricity supply is based 70 per cent on hydro-electricity. The remainder is generated in thermal power plants fuelled with hard coal, lignite, fuel oil, natural gas and other fuels, including biomass.

In accordance with the Second Nationalisation Act of 1947, all of the major utilities had majority state ownership; e.g. the Verbundgesellschaft is 51 per cent owned by the Republic of Austria, and 49 per cent by private investors. There is also cross-ownership in the sector.

On 7 July 1998, the Electricity Act was adopted (Electricity Market and Organisation Law of August 1998 - ElWOG) to transpose the EU Electricity Directive, to introduce competition and to clarify the future structure and functioning of the market. The Act came into force on 19 February 1999. Due to the legal position of the provinces and their majority ownership in the provincial utilities, provincial implementing legislation had to be enacted, as well as several Federal Ministerial Decrees; this occurred in February, September and December 1999. The key provisions obligatory under the EU Directive were in place in February 1999.

The Electricity Act replaced the 1947 Nationalisation Act in all areas except ownership; here, the current ownership of 51 per cent or more in all major utilities (with the exception of three regional suppliers where state ownership is 50 per cent) was confirmed. The exemption of electricity from the national competition law was ended. As far as the new functional mode is concerned, the Electricity Act contains the following provisions:

- *Regulated Third Party Access (regTPA).* Network tariffs are set by the Minister of Economic Affairs by decree. The terms of grid access must be authorised by the provincial governments in co-operation with the Minister of Economic Affairs. Grid operators can refuse grid access only as a means of last resort, and only in situations of grid instability, lack of capacity, lack of reciprocity if the transactions concerned involve foreign companies, or if the transaction would displace generation from renewables or combined heat and power (CHP) facilities. In the latter case, grid access can only be refused if the renewables or CHP generation is economic at the prevailing market prices, and if it cannot be sold elsewhere.

- *Accounting unbundling*. The Electricity Act requires vertically-integrated utilities to separate their generation, transmission, distribution and supply businesses, including their accounts, but the activities can occur under the managerial control of the same entity. Network operators are required to observe confidentiality rules.

- *Eligibility*. Eligibility rules adhere closely to the minimum requirements stipulated in the EU Directive. The Austrian Electricity Act goes beyond the EU Directive in one point: those among the distributors who are also transmission system operators (i.e. some of the nine regional utilities) have also been eligible for competition since February 1999. In addition, larger distributors whose sales exceed 40 GWh in 2001 will be made eligible the following year. This threshold will be reduced to 9 GWh in 2003.

Following entry into force of the Electricity Act, vigorous competition developed in the eligible market segment, causing price cuts that are estimated at up to 50 per cent. Since the beginning of electricity market liberalisation, electricity prices for households decreased 7 per cent on average. Competition has also led to the deferral of some planned new hydro investment, due to overcapacity in the market. As a reaction to this propitious result, the government is now considering to accelerate the liberalisation schedule.

The Electricity Act also contains a number of provisions designed to provide support to the uptake of renewable energies by the market. For example, the Act compels the provinces, as of 2005, to enact legislation requiring distributors to source 3 per cent of their electricity retail sales from renewables. It can also oblige distributors to buy electricity from small hydro facilities. Provinces have to develop promotional tariffs for non-hydro renewables, and are free to do so for small hydro as well, if they wish. As noted above, grid access can be denied if it displaces electricity generated by renewables. Captive consumers are nevertheless allowed to sign supply contracts with utilities other than own utility if the other supplier offers renewables-based electricity.

The Federal Government has a number of support programmes in place, especially for biomass and small-scale hydro. These are complemented by a host of programmes from the provinces and other organisations. Increasingly, programmes for the promotion of renewables are based on calls for tender to introduce an element of competition.

In July 2000 the Energy Liberalisation Act was adopted by the Parliament. This Act, amending the Electricity Act of 1998, brought a number of important changes:

- As of October 2001, the electricity market will be fully liberalised, allowing all electricity consumers to freely choose their electricity supplier.

- The organisational set-up of the new system will be similar to the Scandinavian system, in particular with respect to system balancing and clearing and settlements.

- A support scheme for small hydropower (less than or equal to 10 MW) will be created. This support scheme is based on the obligation for electricity dealers to prove that 8 per cent of their electricity sales stem from small hydro power. This has to be proved by the use of tradable certificates.

- Distribution system operators are obliged to purchase electricity from renewables (excluding hydropower) at promotional tariffs (set by the provincial governors) until a certain share (2001: 1 per cent, 2003: 2 per cent, 2005: 3 per cent, 2007: 4 per cent) of their electricity sales originates from these renewables.

- If the distribution system operator, electricity supplier or final consumer does not meet his renewables obligations, a penalty has to be paid into a fund which will be used for the promotion/financing of renewable power plants.

- Two new independent regulatory bodies will be created (i.e. Electricity Control Ltd. and Electricity Control Commission).

- Electricity suppliers will be obliged to provide information on the primary source of energy which was used for the generation of their electricity (labelling as in the Californian system).

- Import of electricity from third countries, which is produced in plants that are not in accordance with the state of engineering, or constitute a danger to life, property and the environment, is not allowed. The same applies to electricity from plants that cannot prove that waste from electricity generation is disposed of properly.

NATURAL GAS

Austria produces some 20 per cent of its gas consumption, the remainder is imported, mainly from Russia (88 per cent), but also from Norway and Germany. The country has extensive storage capacity equalling one-quarter of annual consumption, and is well connected with the international high-pressure pipeline grid. Gas consumption stands at about 17 per cent of total final consumption (TFC), and hence is somewhat lower than in IEA Europe as a whole, but very significant growth potential has been detected to 2010.

Austria is in the process of transposing the EU Gas Directive into its national Law. To do this, and to update and consolidate existing piecemeal legislation, the Minister of Economic Affairs submitted a draft Gas Bill for discussion among interested parties in July 1999. This Bill proposes negotiated Third Party Access (negTPA) and regulatory control of all relevant aspects by the Minister of Economic Affairs. However, following the lessons learned from power industry liberalisation so far, the Gas Bill suggests opening up 100 per cent of the market to competition, including small consumers.

The Energy Liberalisation Act, adopted by the Parliament in July 2000, includes provisions on a two-step liberalisation of the gas market. Since 10 August 2000 operators of gas-fired electricity generation plants, final consumers with an annual consumption of more than 25 mcm, as well as re-sellers of natural gas, are allowed to freely choose their gas supplier. This first step is in compliance with the EU Directive on the internal market in natural gas. The second step, however, will go far beyond the obligations set by the EU Directive: as of October 2002, the Austrian gas market will be fully liberalised, allowing all consumers of natural gas, irrespective of their annual consumption, to freely choose their supplier.

CLIMATE CHANGE

Under the Kyoto Protocol to the Framework Convention on Climate Change, and the respective EU burden-sharing agreement, Austria is required to reduce its greenhouse gas emissions (six gases) by 13 per cent by the end of the first budget period in 2008-2012. This requires an emissions reduction of about 10 million tonnes of CO_2 equivalent, from 77 million tonnes currently to 67 million tonnes. CO_2 emissions account for 80 per cent of greenhouse gas emissions.

A study on possible measures to address climate change was published in December 1999 and circulated for discussion by interested parties. The study suggests measures in the following sectors of the economy:

- Space heating (thermal insulation);
- Renewables;
- Waste management;
- Transport;
- Industry/technology; and
- Agriculture.

The government was expected to reach agreement on the proposed measures and begin their implementation in 2000. As of September 2000, agreement had not been reached due to open issues relating to content as well as to finance.

Based on the December 1999 study, a Climate Strategy 2000-2008/12 was developed and is now in the last stage of consultation with the relevant stakeholders. It seems likely that an agreement will be reached in the near future.

The Climate Strategy consists of seven packages of measures (space heating/private consumption, electricity and heat production, transport, industry, waste management, agriculture and forestry, and other gases: HFCs, PFCs, SF_6). Both the reduction potential and the necessary financial incentives for these measures are shown in the Strategy.

The Strategy, as the preceding study, contains national measures only, so the use of flexible mechanisms (emissions trading, joint implementation and clean development mechanism) can be seen as reserve measures to reach the Kyoto target. The Strategy will be adapted to changing circumstances.

Apart from support for renewables, measures will be directed at non-CO_2 greenhouse gases as well as at energy efficiency improvements. Much of Austrian energy efficiency policy occurs in the framework of the European Union, but there is also significant domestic support for investment in energy-efficient housing and technology.

AUSTRIA

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**8.0**	**8.4**	**8.9**	**9.0**	**9.7**	**9.9**	**..**
Coal[1]		1.1	0.6	0.3	0.3	0.1	0.1	..
Oil		2.7	1.2	1.0	1.0	0.7	0.6	..
Gas		2.0	1.1	1.2	1.3	1.3	1.0	..
Comb. Renewables & Wastes[2]		0.7	2.7	3.3	3.2	3.9	4.4	..
Nuclear		–	–	–	–	–	–	..
Hydro		1.6	2.7	3.1	3.2	3.5	3.6	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	–	–	–	0.2	0.3	..
TOTAL NET IMPORTS[4]		**14.0**	**17.6**	**19.4**	**20.0**	**21.1**	**22.9**	**..**
Coal1	Exports	0.1	0.0	0.0	–	–	–	..
	Imports	3.1	3.1	3.2	3.0	2.0	1.8	..
	Net Imports	3.0	3.1	3.2	3.0	2.0	1.8	..
Oil	Exports	0.1	0.4	1.4	1.6	0.9	0.9	..
	Imports	9.9	10.4	12.4	13.3	11.4	11.6	..
	Bunkers	–	–	–	–	–	–	..
	Net Imports	9.7	10.0	11.0	11.7	10.5	10.7	..
Gas	Exports	–	–	–	0.0	0.0	0.0	..
	Imports	1.3	4.5	5.1	5.3	8.7	10.5	..
	Net Imports	1.3	4.5	5.1	5.3	8.7	10.4	..
Electricity	Exports	0.4	0.6	0.8	0.9	0.8	0.8	..
	Imports	0.3	0.6	0.8	0.9	0.7	0.8	..
	Net Imports	–0.1	–0.0	–0.1	–0.0	–0.1	–0.0	..
TOTAL STOCK CHANGES		**–0.2**	**–0.3**	**0.5**	**–0.2**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**21.8**	**25.7**	**28.7**	**28.8**	**30.8**	**32.8**	**..**
Coal[1]		4.0	4.1	3.8	3.2	2.1	1.9	..
Oil		12.3	10.9	12.1	12.5	11.1	11.2	..
Gas		3.3	5.2	6.5	6.7	10.0	11.5	..
Comb. Renewables & Wastes[2]		0.7	2.8	3.3	3.2	4.0	4.5	..
Nuclear		–	–	–	–	–	–	..
Hydro		1.6	2.7	3.1	3.2	3.5	3.6	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	–	–	–	0.2	0.3	..
Electricity Trade[5]		–0.1	–0.0	–0.1	–0.0	–0.1	–0.0	..
Shares (%)								
Coal		*18.3*	*16.2*	*13.1*	*11.2*	*6.8*	*5.6*	..
Oil		*56.4*	*42.3*	*42.0*	*43.4*	*36.2*	*34.2*	..
Gas		*15.3*	*20.4*	*22.8*	*23.3*	*32.3*	*34.9*	..
Comb. Renewables & Wastes		*3.3*	*10.7*	*11.5*	*11.1*	*12.9*	*13.7*	..
Nuclear		–	–	–	–	–	–	..
Hydro		*7.4*	*10.6*	*10.8*	*11.1*	*11.3*	*11.0*	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other		–	–	–	–	*0.7*	*0.8*	..
Electricity Trade		*–0.6*	*–0.2*	*–0.2*	–	*–0.3*	*–0.1*	..

0 is negligible, – is nil, .. is not available.

Please note: Forecasts are based on the 1996 submission. Forecasts for final consumption by sector are IEA Secretariat estimates.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**17.0**	**21.1**	**23.8**	**24.2**	**26.6**	**28.4**	**..**
Coal[1]	2.1	1.5	1.5	1.3	1.5	1.4	..
Oil	10.2	9.6	10.7	11.1	10.3	10.4	..
Gas	1.8	3.1	3.8	3.9	6.1	6.9	..
Comb. Renewables & Wastes[2]	0.7	2.5	2.6	2.5	2.7	2.9	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	0.1	0.1	..
Electricity	2.2	3.7	4.2	4.3	4.7	5.3	..
Heat	–	0.6	1.0	1.0	1.3	1.4	..
Shares (%)							
Coal	*12.5*	*7.3*	*6.3*	*5.2*	*5.6*	*5.0*	..
Oil	*59.9*	*45.6*	*45.0*	*46.1*	*38.8*	*36.7*	..
Gas	*10.7*	*14.6*	*16.1*	*16.2*	*22.8*	*24.4*	..
Comb. Renewables & Wastes	*4.1*	*12.1*	*10.9*	*10.5*	*10.1*	*10.0*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	*0.2*	*0.2*	..
Electricity	*12.8*	*17.6*	*17.6*	*17.8*	*17.8*	*18.7*	..
Heat	–	*2.9*	*4.1*	*4.2*	*4.7*	*4.9*	..
TOTAL INDUSTRY[6]	**6.4**	**6.9**	**7.6**	**7.8**	**8.8**	**9.4**	**..**
Coal[1]	0.7	0.9	1.0	0.9	1.1	1.0	..
Oil	3.3	2.2	2.0	2.1	2.5	2.5	..
Gas	1.2	1.8	2.3	2.4	2.8	3.2	..
Comb. Renewables & Wastes[2]	0.0	0.4	0.6	0.6	0.5	0.6	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	1.0	1.6	1.6	1.7	1.8	2.1	..
Heat	–	0.1	0.1	0.1	0.1	0.1	..
Shares (%)							
Coal	*11.4*	*12.5*	*13.3*	*11.8*	*11.9*	*10.6*	..
Oil	*52.4*	*31.7*	*26.7*	*27.4*	*28.0*	*26.2*	..
Gas	*19.2*	*26.8*	*29.8*	*30.7*	*31.9*	*33.9*	..
Comb. Renewables & Wastes	*0.5*	*5.4*	*8.1*	*7.1*	*5.9*	*5.8*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*16.3*	*22.6*	*20.9*	*21.6*	*20.9*	*22.0*	..
Heat	–	*1.0*	*1.2*	*1.5*	*1.4*	*1.5*	..
TRANSPORT[7]	**4.0**	**5.5**	**6.5**	**6.9**	**6.2**	**6.3**	**..**
TOTAL OTHER SECTORS[8]	**6.6**	**8.7**	**9.7**	**9.5**	**11.6**	**12.7**	**..**
Coal[1]	1.3	0.7	0.5	0.4	0.4	0.4	..
Oil	3.1	2.2	2.5	2.4	2.1	2.1	..
Gas	0.6	1.2	1.5	1.5	3.2	3.7	..
Comb. Renewables & Wastes[2]	0.7	2.2	2.0	2.0	2.2	2.3	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	0.1	0.1	..
Electricity	1.0	1.9	2.4	2.3	2.6	2.9	..
Heat	–	0.5	0.9	0.9	1.1	1.3	..
Shares (%)							
Coal	*19.4*	*7.7*	*5.0*	*3.7*	*3.6*	*3.2*	..
Oil	*46.8*	*24.9*	*25.3*	*25.6*	*17.6*	*16.4*	..
Gas	*9.0*	*14.1*	*15.8*	*15.9*	*27.7*	*29.2*	..
Comb. Renewables & Wastes	*9.9*	*25.0*	*20.4*	*20.9*	*18.6*	*18.1*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	*0.5*	*0.6*	..
Electricity	*15.0*	*22.2*	*24.3*	*24.5*	*22.1*	*22.8*	..
Heat	–	*6.2*	*9.2*	*9.4*	*9.8*	*9.9*	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**4.8**	**7.1**	**8.3**	**8.1**	**9.2**	**10.1**	**..**
OUTPUT (Mtoe)	**2.7**	**4.2**	**4.8**	**4.8**	**5.1**	**5.6**	**..**
(TWh gross)	30.9	49.4	55.5	55.9	59.8	64.9	..
Output Shares (%)							
Coal	*10.3*	*14.8*	*11.7*	*9.1*	*2.3*	*1.4*	..
Oil	*14.1*	*4.4*	*5.0*	*5.6*	*1.5*	*1.2*	..
Gas	*14.3*	*14.8*	*15.4*	*15.8*	*20.9*	*23.3*	..
Comb. Renewables & Wastes	*0.7*	*2.3*	*3.1*	*3.0*	*7.0*	*8.3*	..
Nuclear	–	–	–	–	–	–	..
Hydro	*60.6*	*63.7*	*64.8*	*66.5*	*68.2*	*65.8*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
TOTAL LOSSES	**4.7**	**4.4**	**4.9**	**5.0**	**4.1**	**4.5**	**..**
of which:							
Electricity and Heat Generation[10]	2.2	2.2	2.4	2.2	2.6	2.9	..
Other Transformation	1.4	0.8	0.7	0.9	0.3	0.3	..
Own Use and Losses[11]	1.2	1.5	1.8	1.9	1.2	1.2	..
Statistical Differences	**0.1**	**0.1**	**–0.0**	**–0.3**	**–**	**–**	**–**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	104.19	159.50	182.90	188.92	217.01	239.59	..
Population (millions)	7.59	7.72	8.07	8.08	8.15	8.20	..
TPES/GDP[12]	0.21	0.16	0.16	0.15	0.14	0.14	..
Energy Production/TPES	0.37	0.33	0.31	0.31	0.31	0.30	..
Per Capita TPES[13]	2.87	3.33	3.56	3.57	3.77	4.00	..
Oil Supply/GDP[12]	0.12	0.07	0.07	0.07	0.05	0.05	..
TFC/GDP[12]	0.16	0.13	0.13	0.13	0.12	0.12	..
Per Capita TFC[13]	2.24	2.73	2.95	2.99	3.27	3.46	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	58.4	59.3	64.8	62.5	61.7	64.4	..
CO_2 Emissions from Bunkers (Mt CO_2)	–	–	–	–	–	–	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	1.5	0.7	1.6	0.3	0.9	1.3	..
Coal	–1.5	1.2	–1.3	–14.7	–6.0	–2.4	..
Oil	0.7	–1.5	1.5	3.5	–1.6	0.1	..
Gas	4.6	1.7	3.2	2.7	5.8	2.8	..
Comb. Renewables & Wastes	6.3	9.3	2.7	–3.4	3.2	2.4	..
Nuclear	–	–	–	–	–	–	..
Hydro	6.7	1.2	1.9	3.3	1.2	0.7	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	3.1	..
TFC	2.1	0.9	1.8	1.3	1.4	1.3	..
Electricity Consumption	3.9	2.8	1.8	2.1	1.4	2.3	..
Energy Production	0.0	0.4	0.8	1.2	1.0	0.5	..
Net Oil Imports	2.7	–1.2	1.4	6.1	–1.6	0.4	..
GDP	3.0	2.3	2.0	3.3	2.0	2.0	..
Growth in the TPES/GDP Ratio	–1.4	–1.6	–0.3	–2.9	–1.0	–0.7	..
Growth in the TFC/GDP Ratio	–0.8	–1.4	–0.2	–2.0	–0.6	–0.7	..

Please note: Rounding may cause totals to differ from the sum of the elements.

DENMARK

GENERAL ENERGY POLICY

Denmark has a national target of reducing carbon dioxide emissions by 20 per cent by 2005, compared with their 1988 levels. In the context of the EU's burden-sharing arrangements, Denmark has committed itself to reducing its average emissions of greenhouse gases by 21 per cent between 2008 and 2012 compared with their 1990 levels.

Climate 2012 (March 2000) reviews Danish climate policy and is intended to prepare for ratification of the Kyoto Protocol. The report outlines the steps by which the Danish government will meet its obligations. These steps include:

- submitting an action plan for the transport sector;
- updating the energy action plan, *Energy 21;*
- establishing a programme for analysis, development and testing of the Kyoto mechanisms;
- submitting analysis and assessments of greenhouse gas reduction potentials in the agricultural sector; and
- determining future regulation of industrial greenhouse gases.

The Danish energy tax structure includes taxes on carbon and sulphur emissions. Energy tax rates will be gradually increased until 2002 (natural gas taxes until 2008). Industries pay a lower rate of carbon dioxide tax. Different rates apply to space heating, light industrial processes and heavy industrial processes. Reductions in carbon dioxide tax burden are also possible if companies enter into an agreement with the government on carrying out energy efficiency measures.

In June 1999, a forecast for energy consumption and carbon dioxide emissions until 2012 was published in the report *Follow-up on Energy 21: Status of Energy Planning*[1]. A 16.4 per cent reduction in carbon dioxide emissions is forecast for the period 1988 to 2005. On this basis, the national objective of reducing emissions by 20 per cent during this period would not be fulfilled.

Following preparation of the forecast, the green tax package for trade and industry was adjusted. Energy savings from this adjustment, combined with savings resulting from heat and gas reforms and from new initiatives in the transport sector, are expected to result in the 20% reduction goal being met.

1. This document is available in English at www.ens.dk. Other documents mentioned in this review are also expected to be made available in English at this site.

ENERGY EFFICIENCY

Recent initiatives concerning energy efficiency and conservation (described in *Follow-up on Energy 21*) include:

- implementation of procurement strategies;
- adjustment of green tax package;
- subsidies for energy efficient windows (*Project Window*);
- reduction of standby electricity consumption;
- subsidies for energy-efficient boilers fired by natural gas in private houses; and
- energy labelling of new automobiles.

In May 2000, the Danish government passed a new Act concerning promotion of energy conservation. The Act sets the overall framework for co-ordination of, and priority to be given to, energy savings initiatives for all sectors, actors and measures. It enables the appointment of local energy conservation committees to co-ordinate local work to save energy, and initiatives for energy conservation in the public sector. The Act complements requirements for energy savings in the Electricity Supply Act, the Natural Gas Supply Bill and amendments to the Heat Supply Act.

The first in a series of annual reviews on energy savings was presented in September 2000. Targets will be set for the different sectors, and necessary new measures introduced in order to meet the overall target.

The Heat Supply Act was amended to reduce the energy sector's environmental impact by promoting renewable energy, particularly biomass and wind power. Heat will continue to be priced according to actual costs on a non-profit basis. Heat producers will be required to promote energy efficiency, and to reduce the costs related to the production of heat, through benchmarking and plant-specific income caps with the aim of securing a more cost-efficient production of heat.

OIL

On 15 June 1998, 17 licences were awarded for exploration and production of hydrocarbons under the Fifth Licensing Round. The total work programme of this licensing round is the most comprehensive since the first round and resulted in a high degree of activity in 1999. Five additional licences were awarded in 1999, mainly under the Open Door procedure.

Danish oil reserves are estimated to be 238 mcm, an increase of 22 per cent compared to the 1998 assessment and corresponding to 14 years of production at the 1999 level. Oil production is expected to reach 21.7 mcm in 2000 and then to decline over the next few years.

Over the past ten years, expected recovery has increased on average at the same rate as production, and both have more than doubled over the same period. The increased recovery is attributable to further field developments, including the drilling of horizontal wells and the use of water injection, and to new discoveries.

NATURAL GAS

Since gas sales commenced in 1984, Danish natural gas has been supplied under gas sales contracts between DUC and DONG Naturgas A/S. In 1998, DONG Naturgas A/S also started buying gas from the Statoil group (the Lulita Field) and, in 1999, from the Amerada Hess group (the South Arne Field).

The supply of natural gas from the Danish North Sea fields increased to 6.77 billion Nm^3 in 1999. According to the Danish Energy Agency's latest forecast, the gas production will plateau at some 8 billion Nm^3 in 2001.

In 1998, DONG laid a new gas pipeline in the North Sea for transporting gas to the processing facilities onshore at Nybro. The pipeline which increases Danish long-term security of supply and improves the possibilities of exploiting some minor Danish fields, was brought into operation in 1999.

Negotiations have taken place between the government, the regional gas distribution companies and DONG Naturgas about state aid to the gas sector and its future structure in order to prepare for the liberalisation of the Danish gas sector. In June 1999, the government entered into an agreement with the two largest regional gas distribution companies in Denmark, Naturgas Midt-Nord (NGMN) and Hovedstadsregionens Naturgas (HNG). The agreement concerned the structure and the amount of state aid to the gas sector in Denmark. Increased co-operation between the two distribution companies is formalised in the agreement, which implies reduction of the subsidies to the sector from 1 January 2000. The two remaining (and smallest) regional gas distribution companies can join the agreement on the same conditions as NGMN and HNG. Parliament decided to increase the energy tax on natural gas from 1 January 2000, corresponding to approximately 85 per cent of the energy tax on fuel oil.

In July 1999, DONG took over the regional company, Naturgas Syd. With this action, the most serious part of the debt problem in the Danish gas sector was solved.

In March 2000, a Bill for a new Natural Supply Act was introduced to open the natural gas market according to the EU Gas Directive and to ensure that the natural gas supply in Denmark takes into account considerations of security of supply, the national economy, the environment and consumer protection.

ELECTRICITY

Since 1 January 1998, distribution companies and large industrial consumers have been able to trade freely on the electricity market. New Acts on electricity supply and carbon dioxide quotas were passed in June 1999. Some parts of the Acts are subject to EC approval. Under the Acts all other consumers – business enterprises as well as domestic consumers – will be able to make a free choice of electricity supplier before the end of 2002. Special arrangements with some companies ensure that all consumers are supplied electricity on reasonable conditions and at competitive prices both prior to and after full market opening in 2002. These conditions are irrespective of whether consumers exercise freedom to choose their electricity supplier. The electricity production sector has been freed from the existing non-profit principle and is now selling electricity on ordinary market terms. Price regulation ensures that there is no cross-subsidisation from heat to electricity production in CHP plants. Transmission and distribution grids are to act as a public infrastructure at the disposal of all on equal and non-discriminatory terms.

"System-responsible" companies ensure general security of supply, co-ordinate the electricity system as a whole, and implement special demonstration and development programmes for the utilisation of environmentally benign methods of electricity production.

Quotas for carbon dioxide emissions by electricity producers have been introduced, in part to address growth in emissions from net exports of electricity generated by thermal plants. For the period 2001-2003, a ceiling has been set for total carbon dioxide emissions from the electricity sector which will be reduced gradually from 22 million tonnes of carbon dioxide in 2001 to 20 million tonnes in 2003. The quota system is designed to avoid disruptions to trade in electricity with other Nordic countries. Among other things, this is done by means of a "carbon dioxide bank" under which unused quotas can be used in subsequent years. If the annual quota is exceeded, the production companies will have to pay DKK 40[2] per tonne of carbon dioxide from 2001 to 2003. The revenue will be spent on energy-saving measures.

Under the new electricity legislation the share of electricity generated from renewable sources (principally wind turbines) is expected to rise to 20 per cent by the end of 2003. Market mechanisms are to be introduced for trade in renewable energy to safeguard cost-effective development. This renewable energy market will be introduced in stages with a view to the market being functioning fully in 2003. All electricity consumers will be obliged to purchase a growing share of renewable energy from the renewable energy market.

Other recent initiatives concerning renewable and non-conventional fuels include:

- replacement of old and poorly situated wind turbines;

2. In 1999, on average, DKK 1 = US$ 0.145 and Euro 0.1345.

- an offshore wind turbine which will generate 750 MW; and
- an agreement on the use of biomass.

RESEARCH, DEVELOPMENT AND DEMONSTRATION

Energy research activities support the development of:

- renewable energy technologies;
- energy conservation and improved energy efficiency; and
- integrated technologies and systems.

For renewable energy, the focus is on wind energy and biomass. Development of wind energy continues and is now focused on the development of large-scale offshore wind farms. Power plants are being developed for efficient combined heat and power production, based on natural gas and biomass. In addition, the development of photovoltaics is now promoted under a separate programme, to demonstrate building integrated solar energy solutions in collaboration with social building societies.

In the conservation and efficiency area, the focus is on energy-efficient technologies and sociological research on the interaction between behaviour, lifestyle and energy consumption. Energy efficiency in industry is promoted by the "green tax package". Revenue from the tax is allocated to funding of energy-saving measures and to industry-related energy technology development and demonstration measures.

The development of integrated technologies and systems comprises optimisation of energy systems with complex consumption and supply structure, control technologies and methods of process optimisation.

Funds for energy research activities flow mainly from the Danish Energy Research Programme (ERP) and the Danish Programme for Development of Renewable Energy (DPRE). Energy research is an important activity at the Risøe National Laboratory and at the Technical Universities.

The ERP was reviewed in 1999 by an international team brought together by the International Energy Agency. The ERP structure has subsequently been revised. A more limited number of programme areas have been selected for future government support, and collaboration with industry has been strengthened with a view to concentrating the government-supported effort on long-term development. A long-term strategy for future activities is under preparation. The administration of the ERP and DPRE programmes has recently been merged into a new division for renewable energy and energy research in the Danish Energy Agency.

Following partial liberalisation of the electricity market in 1999, development of technology for electricity production and distribution is now financed in part with income from electricity sales under the Public Service Obligation arrangement, in place of direct funding by the utilities.

DENMARK

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**0.40**	**9.98**	**20.26**	**20.18**	**22.93**	**12.22**	**..**
Coal[1]		–	–	0.01	–	–	–	..
Oil		0.07	6.11	11.59	11.66	11.70	5.49	..
Gas		–	2.74	6.96	6.76	8.58	3.80	..
Comb. Renewables & Wastes[2]		0.33	1.08	1.52	1.50	2.07	2.15	..
Nuclear		–	–	–	–	–	–	..
Hydro		0.00	0.00	0.00	0.00	–	–	..
Geothermal		–	0.00	0.00	0.00	–	0.00	..
Solar/Wind/Other[3]		–	0.06	0.18	0.25	0.59	0.77	..
TOTAL NET IMPORTS[4]		**19.85**	**8.14**	**2.23**	**0.19**	**–1.99**	**9.54**	**..**
Coal[1]	Exports	0.04	0.03	0.06	0.10	..	..	..
	Imports	1.91	6.23	7.96	4.87	4.50	5.46	..
	Net Imports	1.87	6.20	7.90	4.77	4.50	5.46	..
Oil	Exports	2.89	5.51	11.47	11.69	0.96	5.52	..
	Imports	21.58	8.73	10.70	11.36	..	..	..
	Bunkers	0.69	0.96	1.50	1.40	1.51	1.51	..
	Net Imports	18.00	2.26	–2.27	–1.73	–2.47	4.00	..
Gas	Exports	–	0.93	2.78	2.51	3.14	1.55	..
	Imports	–	–	–	–	–	–	..
	Net Imports	–	–0.93	–2.78	–2.51	–3.14	1.55	..
Electricity	Exports	0.11	0.42	0.95	0.65	0.88	1.48	..
	Imports	0.09	1.03	0.33	0.28	..	..	..
	Net Imports	–0.02	0.61	–0.62	–0.37	–0.88	–1.48	..
TOTAL STOCK CHANGES		**–0.44**	**0.16**	**–1.37**	**0.44**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**19.81**	**18.28**	**21.12**	**20.80**	**20.95**	**21.76**	**..**
Coal[1]		1.93	6.07	6.59	5.62	4.50	5.46	..
Oil		17.57	8.68	9.57	9.56	9.23	9.50	..
Gas		–	1.79	3.86	4.22	5.44	5.35	..
Comb. Renewables & Wastes[2]		0.33	1.08	1.54	1.52	2.07	2.15	..
Nuclear		–	–	–	–	–	–	..
Hydro		0.00	0.00	0.00	0.00	–	–	..
Geothermal		–	0.00	0.00	0.00	–	0.00	..
Solar/Wind/Other[3]		–	0.06	0.18	0.25	0.59	0.78	..
Electricity Trade[5]		–0.02	0.61	–0.62	–0.37	–0.88	–1.48	..
Shares (%)								
Coal		*9.7*	*33.2*	*31.2*	*27.0*	*21.5*	*25.1*	..
Oil		*88.7*	*47.5*	*45.3*	*46.0*	*44.1*	*43.6*	..
Gas		–	*9.8*	*18.3*	*20.3*	*26.0*	*24.6*	..
Comb. Renewables & Wastes		*1.7*	*5.9*	*7.3*	*7.3*	*9.9*	*9.9*	..
Nuclear		–	–	–	–	–	–	..
Hydro		–	–	–	–	–	–	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other		–	*0.3*	*0.9*	*1.2*	*2.8*	*3.6*	..
Electricity Trade		*–0.1*	*3.3*	*–3.0*	*–1.8*	*–4.2*	*–6.8*	..

0 is negligible, – is nil, .. is not available.

Please note: TPES for a given year strongly depends on the amount of net import of electricity, which may vary substantially from year to year.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**16.15**	**14.06**	**15.76**	**15.71**	**15.83**	**16.24**	**..**
Coal[1]	0.34	0.39	0.37	0.34	0.34	0.34	..
Oil	14.26	8.00	8.02	7.94	7.66	7.88	..
Gas	0.12	1.13	1.81	1.86	2.09	2.12	..
Comb. Renewables & Wastes[2]	0.05	0.20	0.55	0.51	0.57	0.57	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	0.00	0.01	0.01	0.01	0.01	..
Electricity	1.39	2.50	2.74	2.75	2.77	2.88	..
Heat	–	1.84	2.27	2.29	2.41	2.45	..
Shares (%)							
Coal	*2.1*	*2.8*	*2.4*	*2.2*	*2.1*	*2.1*	..
Oil	*88.3*	*56.9*	*50.9*	*50.6*	*48.4*	*48.5*	..
Gas	*0.7*	*8.0*	*11.5*	*11.8*	*13.2*	*13.0*	..
Comb. Renewables & Wastes	*0.3*	*1.4*	*3.5*	*3.3*	*3.6*	*3.5*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*8.6*	*17.8*	*17.4*	*17.5*	*17.5*	*17.7*	..
Heat	–	*13.1*	*14.4*	*14.6*	*15.2*	*15.1*	..
TOTAL INDUSTRY[6]	**4.04**	**2.99**	**3.45**	**3.45**	**3.54**	**3.64**	**..**
Coal[1]	0.21	0.31	0.34	0.32	0.31	0.31	..
Oil	3.41	1.30	1.16	1.14	1.05	1.07	..
Gas	0.02	0.53	0.84	0.88	0.99	1.00	..
Comb. Renewables & Wastes[2]	–	0.02	0.12	0.12	0.11	0.12	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	0.40	0.75	0.86	0.86	0.91	0.98	..
Heat	–	0.07	0.14	0.14	0.17	0.17	..
Shares (%)							
Coal	*5.2*	*10.4*	*9.8*	*9.2*	*8.6*	*8.5*	..
Oil	*84.5*	*43.7*	*33.6*	*33.0*	*29.7*	*29.2*	..
Gas	*0.4*	*17.7*	*24.2*	*25.5*	*27.8*	*27.5*	..
Comb. Renewables & Wastes	–	*0.6*	*3.3*	*3.3*	*3.2*	*3.2*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*9.8*	*25.2*	*24.8*	*24.8*	*25.8*	*26.8*	..
Heat	–	*2.5*	*4.1*	*4.1*	*4.8*	*4.7*	..
TRANSPORT[7]	**3.52**	**4.58**	**4.90**	**4.89**	**5.27**	**5.57**	**..**
TOTAL OTHER SECTORS[8]	**8.59**	**6.50**	**7.42**	**7.37**	**7.03**	**7.03**	**..**
Coal[1]	0.13	0.08	0.03	0.03	0.03	0.03	..
Oil	7.34	2.14	1.98	1.94	1.41	1.31	..
Gas	0.10	0.60	0.97	0.98	1.10	1.12	..
Comb. Renewables & Wastes[2]	0.05	0.18	0.44	0.40	0.45	0.46	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	0.00	0.01	0.01	0.01	0.01	..
Electricity	0.98	1.73	1.86	1.87	1.79	1.84	..
Heat	–	1.76	2.13	2.15	2.24	2.28	..
Shares (%)							
Coal	*1.5*	*1.2*	*0.4*	*0.3*	*0.4*	*0.4*	..
Oil	*85.4*	*33.0*	*26.8*	*26.3*	*20.1*	*18.7*	..
Gas	*1.2*	*9.3*	*13.1*	*13.3*	*15.7*	*15.9*	..
Comb. Renewables & Wastes	*0.6*	*2.8*	*5.9*	*5.4*	*6.5*	*6.5*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	*0.1*	*0.1*	*0.1*	*0.1*	..
Electricity	*11.4*	*26.6*	*25.1*	*25.3*	*25.5*	*26.1*	..
Heat	–	*27.2*	*28.7*	*29.2*	*31.8*	*32.4*	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**4.69**	**7.36**	**10.18**	**9.53**	**9.97**	**11.35**	**..**
OUTPUT (Mtoe)	**1.64**	**2.21**	**3.81**	**3.53**	**3.89**	**4.61**	**..**
(TWh gross)	19.12	25.74	44.31	41.08	45.28	53.58	..
Output Shares (%)							
Coal	*35.8*	*90.6*	*64.8*	*57.6*	*40.1*	*42.3*	..
Oil	*64.1*	*4.1*	*12.2*	*12.1*	*10.0*	*8.8*	..
Gas	–	*2.6*	*15.5*	*19.9*	*28.6*	*26.2*	..
Comb. Renewables & Wastes	–	*0.2*	*3.0*	*3.5*	*8.3*	*7.7*	..
Nuclear	–	–	–	–	–	–	..
Hydro	*0.1*	*0.1*	*0.0*	*0.1*	–	–	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	*2.4*	*4.5*	*6.9*	*13.0*	*14.9*	..
TOTAL LOSSES	**3.74**	**4.19**	**5.14**	**4.85**	**5.12**	**5.52**	**..**
of which:							
Electricity and Heat Generation[10]	3.04	2.85	3.38	3.00	3.16	3.78	..
Other Transformation	0.44	–0.01	–0.27	–0.13	0.00	0.00	..
Own Use and Losses[11]	0.26	1.34	2.02	1.98	1.96	1.74	..
Statistical Differences	**–0.08**	**0.03**	**0.23**	**0.25**	**–**	**–**	**..**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	98.45	133.36	160.69	165.42	188.64	208.27	..
Population (millions)	5.02	5.14	5.28	5.30	5.40	5.44	..
TPES/GDP[12]	0.20	0.14	0.13	0.13	0.11	0.10	..
Energy Production/TPES	0.02	0.55	0.96	0.97	1.09	0.56	..
Per Capita TPES[13]	3.94	3.56	4.00	3.92	3.88	4.00	..
Oil Supply/GDP[12]	0.18	0.07	0.06	0.06	0.05	0.05	..
TFC/GDP[12]	0.16	0.11	0.10	0.09	0.08	0.08	..
Per Capita TFC[13]	3.22	2.73	2.98	2.96	2.93	2.99	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	59.4	52.9	62.5	59.6	56.8	61.1	..
CO_2 Emissions from Bunkers (Mt CO_2)	2.2	3.1	4.7	4.4	4.7	4.7	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	1.2	–1.4	2.1	–1.5	0.1	0.8	–
Coal	14.4	3.1	1.2	–14.8	–3.1	3.9	–
Oil	–1.4	–5.5	1.4	–0.1	–0.5	0.6	–
Gas	–	–	11.7	9.4	3.7	–0.3	–
Comb. Renewables & Wastes	6.5	7.6	5.2	–1.2	4.5	0.8	–
Nuclear	–	–	–	–	–	–	–
Hydro	–	–	–	–	–	–	–
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	44.0	18.2	41.2	10.8	6.3	–
TFC	0.6	–1.6	1.6	–0.3	0.1	0.5	–
Electricity Consumption	4.9	2.8	1.3	0.3	0.1	0.8	–
Energy Production	15.0	24.2	10.6	–0.4	1.8	–11.8	–
Net Oil Imports	–2.6	–16.0	–	–24.1	5.3	–	–
GDP	1.9	1.8	2.7	2.9	1.9	2.0	–
Growth in the TPES/GDP Ratio	–0.7	–3.1	–0.6	–4.3	–1.8	–1.2	–
Growth in the TFC/GDP Ratio	–1.3	–3.3	–1.0	–3.2	–1.7	–1.5	–

Please note: Rounding may cause totals to differ from the sum of the elements.

GERMANY

GENERAL ENERGY POLICY

Following the change of government in September 1998, the responsibility for energy research was transferred from the Federal Ministry of Education and Research (BMBF) to the Federal Ministry of Economics and Technology (BMWi). The BMWi is responsible for energy policy in the Federal Government, and, since September 1999, has been located in Berlin.

The new administration aims to ensure energy efficiency, energy security and environment protection. In this context, it gives value to renewable energy and to energy conservation.

One objective of the coalition parties forming the government is to organise the full and irreversible phasing-out of nuclear power during the legislative period of 1998-2002. The Federal Government is preparing a plan for this phasing-out without financial compensation to the owners of the nuclear power plants, if possible with the agreement of the power companies. In addition, at end 1998, the government decided to phase out foreign reprocessing of spent nuclear fuels and to build intermediate repositories at the reactor sites; a related amendment to the atomic law has not yet been initiated.

The BMWi launched the "Energy Dialogue 2000" in the summer of 1999. The Dialogue is aimed at reaching consensus on guidelines for recommendations for future energy policy objectives and measures, excluding questions concerning the phasing-out of nuclear power, through a broad-based discussion process between Germany's economic and social groups.

SUPPLY AND DEMAND TRENDS

From 1990 to 1998, total primary energy supply (TPES) decreased more than 3 per cent. In 1998, TPES was 344.5 Mtoe, a 0.8 per cent decrease from its 1997 level, and total final consumption (TFC) remained at the same level of 243.2 Mtoe.

Total oil supply was 140 Mtoe in 1998, a slight increase from 1997. In 1998, there were 14 refineries in Germany with a total capacity of 109.8 million tonnes; 89.1 million tonnes of this capacity was located in the old Laender and 20.8 million tonnes in the new Laender. Capacity utilisation in refineries was 98 per cent. This level was 89.1 per cent in the new Laender, substantially above the 1997 figure of 83 per cent, and was nearly 100 per cent in the old Laender. The Leuna refinery, which started operation in November 1997, made a large contribution to the increase in refinery processing in 1998.

In 1998, hard coal production fell 11.1 per cent to 29.5 Mtoe, a higher rate of decline than in previous years. German imports of hard coal (including briquettes and coke) increased by 12.7 per cent to 17.8 Mtoe in 1998. German hard coal exports fell 45 per cent to their lowest level of 0.5 Mtoe.

The BMWi commissioned two institutes, PROGNOS AG of Basle and the Energy Department of the University of Cologne (EWI), to forecast energy consumption in Germany until 2020. The forecast, entitled "The Long-term Development of Energy Markets in the Light of Competition and Environment", was presented in October 1999. The two institutes are solely responsible for the assumptions and the findings.

Given the economic growth assumption of 1.9 per cent per year from 2000 to 2020, PROGNOS/EWI experts believe that primary energy consumption will decline by 5 per cent during this period. PROGNOS/EWI assume that, with the exception of industry where energy consumption is expected to stagnate after 2010, energy consumption will decline in all other sectors, mainly due to expected improvements in energy efficiency.

By 2020, final energy consumption by households will drop by 6 per cent and by other small consumers by 3 per cent. In industry, consumption will rise by 5 per cent up to 2010 and then stagnate because of the slowdown in industrial production (especially in the metal industry) and improvements in energy efficiency. Final energy consumption will also rise in the transport sector until 2010, and then decline mainly because of a decrease in the average automobile fuel consumption to 6.1 litres per 100 km. In 2020, energy consumption in the transport sector will be roughly at its 1997 level. As a consequence of falling energy demand and increased economic growth, energy intensity will decrease by an average rate of 2.1 per cent per year.

In addition to the decrease in energy consumption, the fuel mix in primary energy supply will change substantially[1]:

- The share of natural gas will rise from 21 per cent in 1998 to 26.1 per cent in 2015.
- The contribution of nuclear power will fall – assuming a phase-out after 35 calendar years – from 12.2 per cent to 8 per cent.
- Hard coal and lignite will lose a small amount of their shares in TPES.
- The share of renewable energy will nearly double.

Energy production is expected to fall from 131.5 Mtoe in 1998 to 102.1 Mtoe in 2015, mostly because:

1. IEA's Energy Balances and Key Statistical Data show forecasts until 2015. Data indicated in the table at the end of this review may differ from PROGNOS/EWI forecasts due to different conversion factors.

- Hard coal production will decrease from 29.5 Mtoe in 1998 to 14 Mtoe in 2015.
- Lignite production will stay at a level comparable to that of 1998 (34.7 Mtoe).
- Nuclear energy will decrease from 42.1 Mtoe in 1998 to 27.4 Mtoe in 2015.

However, non-hydro renewable energy will increase from 5.9 Mtoe in 1998 to 11.3 Mtoe in 2015, i.e. 11.1 per cent of total energy production.

Electricity generation is expected to increase from 552.4 TWh in 1998 to 607.5 TWh in 2015. The reduction in nuclear will be replaced with natural gas generation, while coal will maintain its share. Electricity net imports will increase.

TAX POLICY

The Federal Government's economic policy priorities for 1999 included the introduction of an Ecological Tax (Eco-Tax). The Eco-Tax aims at improving the use of energy and at reducing the cost of labour. This tax has been set in two stages: from 1 April 1999 to January 2000 and from 2000 to 2003 (see Table 1). Coal is not taxed. Tax increases for the manufacturing industry and for agriculture amount to 20 per cent of the normal rate. The tax also provides for further rebates for energy intensive industries. Railway companies pay 50 per cent of the new tax.

Table 1
Eco-Tax, 1999 and 2003

	Energy	*Tax Increase*
	1999	*2003*
Electricity		
Standard Rate	2 Pf/kWh	4 Pf/kWh
Night Storage Heaters [2]	1 Pf/kWh	2 Pf/kWh
Manufacturing Industry	0.4 Pf/kWh	0.8 Pf/kWh
Gasoline/Diesel	6 Pf/litre	30 Pf/litre
Heating Oil		
Standard Rate	4 Pf/litre	4 Pf/litre
Manufacturing Industry	0.8 Pf/litre	0.8 Pf/litre
Natural Gas		
Standard Rate	0.32 Pf/kWh	0.32 Pf/kWh
Manufacturing Industry	0.064 Pf/kWh	0.064 Pf/kWh

2. This reduced rate only applies to night storage heaters installed before 1 April 1999.

The second stage was adopted by the Bundestag on 27 November 1999 and includes the following additional measures for the period 2000 to 2003:

- An annual increase in gasoline and automotive diesel tax rates by 6 pfennigs/litre[3].
- The electricity tax will be raised by 0.5 pfennig/kWh per year.
- The introduction of a uniform tax rate for heavy fuel oil of DM 35/t. Prior to 2000, the rate was DM 30/t on the heating market and DM 55/t on electric power generation.
- The law provides for special incentives for highly efficient co-generation and for gas turbine equipment.
- A special programme to promote renewable energies is financed with revenues from the Eco-Tax.

The government expects that additional tax revenues in the period 2000 to 2003 from the Eco-Tax will amount to more than DM 35 billion. These funds will be used to lower by 2 per cent the social security contributions of companies and employed persons.

ENERGY EFFICIENCY

In 1998 and 1999 the main measures adopted in the field of energy efficiency included the following:

- In June 1998, the ordinance on maximum energy consumption values was adopted to implement the EU directive on energy efficiency requirements for refrigerators and freezers.
- At end 1998, the Federal Government launched a project aimed at modernising energy consultancy services for private consumers: a nation-wide computer-assisted self-information system ("energy manager") using CD-ROM/Internet was introduced and is being tested in a pilot phase in North-Rhine-Westphalia.
- The Eco-Tax was introduced (see above).
- In December 1999, a new ordinance on energy consumption labelling for domestic bulbs and dishwashers came into force.
- The BMWi has been preparing a new ordinance on energy conservation to optimise thermal insulation and heating equipment in buildings. The Ministry expects that

3. In 1998, DM 1 = US$ 0.57; DM 1 = Euro 0.51; DM 1 = Pf 100.

the implementation of this measure will result in a reduction of energy demand for heating in new buildings by roughly 30 per cent compared with the level achieved under the previous regulation. The draft ordinance also contains provisions for retrofitting existing buildings. By 2005, obsolete heating boilers must be replaced. This provision is expected to affect about 3 million boilers.

- In September 1999, the DM 200 million programme to promote renewable energy (see below) commenced for some thermal insulation measures in existing buildings, if these measures are undertaken in combination with the installation of thermal solar collectors.

ENERGY AND THE ENVIRONMENT

The government target is to achieve a 25 per cent decrease in CO_2 emissions between 1990 and 2005. At Kyoto, the EU and other developed countries agreed to cut their greenhouse gas (GHG) emissions by a total of 8 per cent between 1990 and 2010. Under the terms of a European Union allocation agreement, Germany decided to cut its GHG emissions by 21 per cent.

According to official estimates, energy-related CO_2 emissions decreased 13.2 per cent between 1990 and 1998, reaching 876 million tonnes in 1998. IEA statistics indicate that energy-related CO_2 emissions decreased 10.7 per cent between 1990 and 1998. The IEA sees energy-related CO_2 emissions falling by 12.3 per cent between 1990 and 2010, a level comparable to the decrease of 14 per cent forecast by PROGNOS/EWI.

COAL

The number of mines fell from 17 to 15 in 1998, and three other mines are expected to be closed in 2000. The reduction in production capacities is also planned to continue in 2000. The Ewald/Hugo pit was closed in advance at the end of April 2000. Its closure had initially been planned for 2002, but falling international coal prices forced an earlier closure. The workforce in German coal mining dropped from 78,100 at the end of 1997 to 71,800 at the end of 1998.

German hard coal production has been concentrated in one company after RAG Aktiengesellschaft (RAG) took control of Saarbergwerke in October 1998 and of the coal activities of Preussag Anthrazit on 1 January 1999. At the same time, RAG also took over the substantial non-coal mining assets of Saarbergwerke as well as a small gas-fired power plant from Preussag Anthrazit. RAG created a new company, Deutsche Steinkohle A.G. (DSK), to run the coal mining business.

On 1 April 1998, the Haus Aden/Monopol and Heinrich Robert mines were merged to form Verbundbergwerk Ost. At the same time, the Fürst Leopold/Wulfen and

Westerholt mines joined to form Verbundbergwerk Lippe. On 30 June 2001, the Auguste Victoria and Blumenthal mines are to be merged, followed by the Friedrich Heinrich/Rheinland and Niederberg mines on 1 January 2002.

On 1 January 1998, the law reorganising hard-coal subsidies entered into force[4]. It provides compensations for the use of German hard coal in power stations and in the production of blast-furnace steel which are aimed at bringing down the price of domestic coal to international levels. The law also provides for government contributions to help cover the expenses resulting from the closure of mines.

Subsidies to hard coal production, calculated by the IEA in the Producer Subsidy Equivalent were estimated to be DM 8,716 million in 1999, a slight decrease over 1998 (see Table 2).

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION

The new government endorsed the 1996 Fourth Energy Research and Energy Technology Programme which aims at:

- Reducing energy-related CO_2 emissions and other emissions.
- Strengthening technology capabilities in Germany and improving export opportunities.

Public funding to energy R&D was DM 527.1 million in 1999, down from 547.8 million in 1998. Nuclear had the highest share with 57.3 per cent followed by renewable energies (25.4 per cent). Public funding is expected to increase to DM 536.4 billion in 2000. As a consequence of the consolidation of the Federal budget, the level of public support for energy research will not increase over the next few years. Greater efforts are therefore being made to ensure that the scarcer funding is used in a targeted and efficient manner.

LIGNITE

In 1998, lignite production in Germany decreased 6.3 per cent to 34.7 Mtoe. The decrease was mostly due to the 13.1 per cent reduction in production in the mines of Lausitz and Central Germany. Total workforce declined by about 3,200 between the end of 1997 and the end of 1998 to 26,200 (13,500 in the new Laender and 12,700 in the old Laender); 2,900 of these jobs were lost in the new Laender.

4. For more detailed information, see *Energy Policies of IEA Countries: Germany 1998 Review*, IEA, 1998.

NATURAL GAS

In 1998, natural gas production was 15.7 Mtoe. Natural gas supplies increased 1.9 per cent to 72.7 Mtoe. 79.6 per cent of natural gas consumption was imported, mostly from Russia (34.9 per cent of gas imports) followed by the Netherlands (21.2 per cent) and Norway (19.8 per cent).

According to initial estimates, investments by the gas industry in 1998 totalled DM 5.65 billion, of which 73 per cent went into modernising and expanding the transport grid. A few more major pipeline construction projects of regional significance were undertaken to remove the last “missing patches” in the German gas supply system. In addition to these investments in transport, DM 400 million went into storage facilities. In 1998, Germany had 39 underground gas storage facilities in operation with a storage capacity totalling 16.1 Mtoe.

The 1998 Energy Law introduced competition in the natural gas market. A law is being drafted to fully implement the EU Gas Directive by August 2000. The private sector intends to reach a consensus to elaborate an inter-association agreement on the conditions of access to the grid.

ELECTRICITY

In 1998, gross electricity generation in Germany increased 0.8 per cent to 552.4 TWh. Coal (hard coal and lignite) accounted for 54.2 per cent, natural gas for 9.8 per cent and nuclear power for 29.3 per cent. The share of nuclear decreased while that of natural gas and coal increased.

In April 1998, the Energy Law was passed allowing all electricity consumers to choose their suppliers. The EU Commission approved the provision of the Energy Law which allows, up to 2003, the electricity company VEAG, situated in the new Laender, to refuse access to its grid when lignite-fired power plants are threatened. The EU Commission set several restrictions to this provision; in particular, consumers purchasing in excess of 100 GWh per year may not be refused network access.

As a consequence of the Law, competition is developing rapidly in the electricity sector. At end 1999, two mergers were decided; VIAG with VEBA and RWE with VEW. The Federal Cartel Office and the EU Commission need to approve these mergers.

Tariff calculations for the use of the grid have been renegotiated between electricity suppliers and consumers. A new system tariff has been set for the period from January 2000 to January 2002. The system separates the country into two parts, north and south, and a fee is required when crossing the separation.

Table 2

IEA Secretariat Estimates of Assistance to German Coal Producers

(in million DM or DM per tonne)

Assistance Category [a]	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999p*
I. ASSISTANCE INCLUDED IN PRODUCER SUBSIDY EQUIVALENT									
1. Direct aid to current production									
a) Investment grants/grants to promote innovation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b) Miners' bonuses	127.5	120.0	104.0	96.8	95.1	97.0	87.0	81.0	64.0
c) Special grants and debt claim payments	305.3	305.3	232.9	212.8	30.2	30.2	30.2	30.2	0.0
d) Special grant to promote sales of coking coal	3 436.8	3 390.0	3 192.7	2 753.4	2 588.7	2 539.2	[c]2 580.7	[d]0.0	[d]0.0
e) Equalisation for area price differences/low volatile coal	429.9	401.5	411.7	244.8	181.9	164.0	0.0	0.0	0.0
f) Special grant to promote sales of thermal coal	0.0	0.0	0.0	0.0	0.0	7 500.0	7 000.0	[d]8 652.0	[d]8 652.0
Subtotal	**4 299.5**	**4 216.8**	**3 941.3**	**3 307.8**	**2 895.9**	**10 330.4**	**9 697.9**	**8 763.2**	**8 716.0**
2. Indirect aid to current production									
g) Special capital depreciation measures	5.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
h) Excess deficit payments to miners' pension fund	270.4	402.2	443.1	491.0	500.0	457.0	444.1	[e]	[e]
3. Price support									
i) Refunds through the thermal coal levy	4 972.4	5 488.4	4 970.0	6 071.2	5 787.2	0.0	0.0	0.0	0.0
j) Estimated additional consumer payments for:									
– thermal coal [b]	1 931.7	2 206.6	2 007.0	3 000.0	3 000.0	0.0	0.0	0.0	0.0
– coking coal [b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total PSE (million DEM)	**11 479.0**	**12 316.0**	**11 361.4**	**12 870.0**	**12 183.1**	**10 787.4**	**10 195.9**	**8 763.2**	**8 716.0**
Total PSE (million USD)	**6 919.2**	**7 884.8**	**6 873.2**	**7 929.8**	**8 501.8**	**7 167.7**	**5 880.0**	**4 981.9**	**4 755.0**
DM per tonne produced	**157.8**	**170.7**	**177.0**	**223.3**	**207.0**	**202.9**	**199.1**	**193.3**	**199.9**
US$ per tonne produced	**95.1**	**109.3**	**107.1**	**137.6**	**144.4**	**134.8**	**114.8**	**109.9**	**109.0**
Production (million tonnes)	72.7	72.2	64.2	57.6	58.9	53.2	51.2	45.3	43.6
US$/DM exchange rate (OECD figures)	1.659	1.562	1.653	1.623	1.433	1.505	1.734	1.757	1.833

p Preliminary data, subject to revision.

[a] Definitions of categories are in Appendix D of *Coal Prospects and Policies in IEA Countries: 1987 Review* (Paris: OECD, 1988).

[b] Support additional to Item 3)i) arising from the differences between domestic and external market prices.

[c] 808.43 million DM of this paid in 1998.

[d] Grants for sales of thermal and coking coal, as well as aid for closures, are now one financial measure.

[e] As of 1998, all payments to the miner's fund are reported as "assistance not benefiting current production" – item 5q.

Source: Adapted and updated from *Energy Policies of IEA Countries: Germany 1998 Review* (Paris: OECD, 1998).

Table 2 (continued)

IEA Secretariat Estimates of Assistance to German Coal Producers

(in million DM or DM per tonne)

Assistance Category [a]	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999p*
II. ASSISTANCE NOT BENEFITING CURRENT PRODUCTION									
1. Aid to promote industry contraction									
k) Closure bonuses and other aid to help cover companies' expenditures resulting from industry contraction	0.0	0.0	0.0	0.0	0.0	0.0	604.3	606.3	607.7
l) Early retirement and other "adaptation" money	270.4	324.0	447.0	491.9	498.7	456.9	444.1	444.3	394.1
2. m) Aid to control water contamination from closed mines and to help prevent subsidence	216.3	199.0	196.0	140.2	191.9	197.3	201.3	107.6	2.9
3. n) Research and development aid [f]	83.0	71.0	45.0	41.0	30.0	23.0	26.0	23.0	19.0
4. Miscellaneous assistance									
o) Aid to maintain "Security stocks"	60.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
p) Aid to encourage CHP and district heating	13.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5. q) Deficit payment to miners' pension scheme [g]	10 834.0	11 131.0	12 933.0	12 442.0	12 000.0	12 000.0	13 704.0	13 907.4	14 294
Total assistance not benefiting current production (million DM)	**11 476.5**	**11 736.8**	**13 621.0**	**13 114.1**	**12 721.9**	**12 677.3**	**14 978.8**	**15 087.2**	**15 317.7**

p Preliminary data, subject to revision.
[a] Definitions of categories are in Appendix D of *Coal Prospects and Policies in IEA Countries: 1987 Review* (Paris: OECD, 1988).
[f] Assistance directly related to coal production and transformation.
[g] Obligatory payments under social legislation for the mining-related industry. About 70 per cent can be attributed to hard coal workers.

Source: Adapted and updated from *Energy Policies of IEA Countries: Germany 1998 Review* (Paris: OECD, 1998).

RENEWABLE ENERGY

In 1998, non-hydro renewable energy was 4.4 Mtoe, i.e. 1.3 per cent of total energy supply and 2.4 per cent of electricity supply. Hydropower remained modest with 1.5 Mtoe, i.e. 3.1 per cent of electricity supply.

The government set the following goals to improve the competitiveness of renewable energies and to lift obstacles to their use:

- Improve the competitiveness of renewable energies.
- Improve the legal, administrative and institutional framework.
- Improve the dissemination of information and advice.
- Improve training.
- Promote research, development, demonstration and dissemination.

To reach these goals, the following main measures were decided:

- The BMWi set a DM 100 million incentive programme for renewable energy technology dissemination in the market for the period 1995-1998. A budget of DM 200 million per year was set for 1999 through 2003.
- The Law on Feeding Electricity from Renewable Energies into the Public Grid provides for minimum payments for electricity from renewables. In February 2000, this law was amended. The pay-back tariff is no longer set as a percentage of prices to final consumers but as a fixed amount. The cost of support is shared by all utilities.
- The "100,000 Roofs Solar Power Programme" has been set for the period 1999 to 2005. A total of DM 1.1 billion is being provided by the Federal Government to support the installation of solar photovoltaic equipment through low-interest loans.
- In September 1999, the Federal Government introduced a newly designed promotion programme aimed at supporting renewable energy. The programme is to run until 2003. A total budget of DM 1 billion supports, within certain limits, the installation of thermal solar collectors and grants or low-interest loans for energy conservation measures in buildings.

GERMANY

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**171.7**	**185.7**	**139.7**	**131.5**	**127.8**	**116.9**	**102.1**
Coal[1]		141.4	121.8	70.2	64.1	56.1	51.0	48.5
Oil		6.8	4.9	3.5	3.6	2.0	1.6	1.3
Gas		16.4	13.5	16.1	15.7	14.4	13.1	11.7
Comb. Renewables & Wastes[2]		2.5	4.1	3.8	4.0	7.8	8.3	8.8
Nuclear		3.2	39.8	44.4	42.1	44.2	39.1	27.4
Hydro		1.3	1.5	1.5	1.5	1.8	1.9	1.9
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	0.0	0.3	0.4	1.4	2.0	2.5
TOTAL NET IMPORTS[4]		**167.3**	**165.3**	**208.0**	**212.6**	**223.2**	**233.5**	**239.2**
Coal[1]	Exports	18.3	8.2	0.9	0.5	0.1	0.1	0.1
	Imports	15.2	11.5	15.8	17.8	20.2	23.1	24.7
	Net Imports	–3.1	3.3	14.9	17.3	20.1	23.0	24.7
Oil	Exports	9.9	10.2	16.4	16.7	14.8	14.6	14.3
	Imports	171.1	132.9	153.8	158.1	155.4	154.7	152.1
	Bunkers	4.1	2.5	2.2	2.1	1.9	1.8	1.8
	Net Imports	157.1	120.2	135.2	139.3	138.7	138.4	136.1
Gas	Exports	0.1	0.9	3.0	3.3	2.7	2.9	3.1
	Imports	12.4	42.7	61.1	59.3	66.2	74.1	80.5
	Net Imports	12.3	41.7	58.1	56.0	63.5	71.2	77.4
Electricity	Exports	0.7	2.7	3.5	3.4	1.9	1.7	1.4
	Imports	1.7	2.7	3.3	3.3	2.8	2.6	2.5
	Net Imports	1.0	0.1	–0.2	–0.1	0.9	0.9	1.1
TOTAL STOCK CHANGES		**–1.1**	**4.7**	**–0.5**	**0.4**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**337.9**	**355.7**	**347.3**	**344.5**	**350.9**	**350.4**	**341.3**
Coal[1]		139.4	128.5	86.3	83.8	76.2	74.0	73.2
Oil		161.9	126.7	139.3	140.0	140.7	140.0	137.4
Gas		28.7	55.0	71.9	72.7	78.0	84.2	89.1
Comb. Renewables & Wastes[2]		2.5	4.1	3.8	4.0	7.8	8.3	8.8
Nuclear		3.2	39.8	44.4	42.1	44.2	39.1	27.4
Hydro		1.3	1.5	1.5	1.5	1.8	1.9	1.9
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	0.0	0.3	0.4	1.4	2.0	2.5
Electricity Trade[5]		1.0	0.1	–0.2	–0.1	0.9	0.9	1.1
Shares (%)								
Coal		*41.2*	*36.1*	*24.8*	*24.3*	*21.7*	*21.1*	*21.4*
Oil		*47.9*	*35.6*	*40.1*	*40.6*	*40.1*	*39.9*	*40.3*
Gas		*8.5*	*15.5*	*20.7*	*21.1*	*22.2*	*24.0*	*26.1*
Comb. Renewables & Wastes		*0.7*	*1.2*	*1.1*	*1.2*	*2.2*	*2.4*	*2.6*
Nuclear		*0.9*	*11.2*	*12.8*	*12.2*	*12.6*	*11.2*	*8.0*
Hydro		*0.4*	*0.4*	*0.4*	*0.4*	*0.5*	*0.5*	*0.6*
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other		–	–	*0.1*	*0.1*	*0.4*	*0.6*	*0.7*
Electricity Trade		*0.3*	–	*–0.1*	–	*0.3*	*0.3*	*0.3*

0 is negligible, – is nil, .. is not available.

Please note: All data include the new Laender of Germany. In the forecast data, gas works gas is included with coal instead of with gas. Statistical differences in both coal and gas are due to differences between production and consumption in the German "Energiebilanzen".

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**246.6**	**246.6**	**243.3**	**243.2**	**260.0**	**261.7**	**260.3**
Coal[1]	53.1	37.3	13.2	11.2	13.2	11.6	10.2
Oil	138.2	117.7	129.0	129.1	131.0	130.3	128.0
Gas	21.1	41.0	51.8	53.1	59.6	61.7	62.9
Comb. Renewables & Wastes[2]	1.7	2.3	1.3	1.3	4.3	4.3	4.4
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	0.3	0.5	0.7
Electricity	26.9	39.1	39.7	40.1	42.9	44.6	45.7
Heat	5.5	9.1	8.2	8.3	8.6	8.6	8.4
Shares (%)							
Coal	*21.5*	*15.1*	*5.4*	*4.6*	*5.1*	*4.4*	*3.9*
Oil	*56.0*	*47.7*	*53.0*	*53.1*	*50.4*	*49.8*	*49.2*
Gas	*8.6*	*16.6*	*21.3*	*21.8*	*22.9*	*23.6*	*24.2*
Comb. Renewables & Wastes	*0.7*	*0.9*	*0.5*	*0.5*	*1.6*	*1.6*	*1.7*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	*0.1*	*0.2*	*0.3*
Electricity	*10.9*	*15.9*	*16.3*	*16.5*	*16.5*	*17.1*	*17.5*
Heat	*2.2*	*3.7*	*3.4*	*3.4*	*3.3*	*3.3*	*3.2*
TOTAL INDUSTRY[6]	**105.9**	**88.7**	**78.0**	**77.8**	**86.4**	**88.8**	**90.8**
Coal[1]	28.7	20.7	10.5	9.5	12.2	11.0	9.7
Oil	46.9	27.3	28.6	29.0	30.9	31.8	33.0
Gas	13.3	19.7	19.9	20.2	23.3	25.1	26.7
Comb. Renewables & Wastes[2]	0.0	–	0.1	0.1	0.3	0.3	0.3
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	15.3	18.6	17.7	17.9	18.1	18.9	19.5
Heat	1.6	2.4	1.2	1.1	1.6	1.7	1.7
Shares (%)							
Coal	*27.1*	*23.3*	*13.4*	*12.2*	*14.1*	*12.3*	*10.7*
Oil	*44.3*	*30.8*	*36.7*	*37.3*	*35.7*	*35.9*	*36.3*
Gas	*12.6*	*22.2*	*25.5*	*26.0*	*27.0*	*28.3*	*29.4*
Comb. Renewables & Wastes	–	–	*0.2*	*0.2*	*0.3*	*0.3*	*0.4*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*14.5*	*21.0*	*22.7*	*23.0*	*21.0*	*21.3*	*21.5*
Heat	*1.5*	*2.7*	*1.5*	*1.4*	*1.9*	*1.9*	*1.8*
TRANSPORT[7]	**39.7**	**60.0**	**65.1**	**66.2**	**67.3**	**67.4**	**65.8**
TOTAL OTHER SECTORS[8]	**101.0**	**97.9**	**100.2**	**99.2**	**106.2**	**105.5**	**103.7**
Coal[1]	22.7	16.6	2.7	1.7	1.0	0.7	0.5
Oil	54.2	31.6	36.8	35.3	34.5	33.0	31.3
Gas	7.8	21.3	31.9	32.9	36.3	36.6	36.1
Comb. Renewables & Wastes[2]	1.7	2.3	1.2	1.2	3.9	3.9	3.8
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	0.3	0.5	0.7
Electricity	10.7	19.3	20.5	20.8	23.2	24.0	24.5
Heat	3.9	6.7	7.0	7.2	7.0	6.9	6.8
Shares (%)							
Coal	*22.5*	*16.9*	*2.7*	*1.7*	*1.0*	*0.6*	*0.4*
Oil	*53.6*	*32.3*	*36.8*	*35.6*	*32.5*	*31.3*	*30.2*
Gas	*7.7*	*21.8*	*31.9*	*33.2*	*34.2*	*34.6*	*34.8*
Comb. Renewables & Wastes	*1.7*	*2.3*	*1.2*	*1.2*	*3.7*	*3.7*	*3.7*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	*0.3*	*0.5*	*0.7*
Electricity	*10.6*	*19.8*	*20.5*	*21.0*	*21.8*	*22.8*	*23.6*
Heat	*3.9*	*6.9*	*7.0*	*7.3*	*6.6*	*6.5*	*6.5*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**98.6**	**141.2**	**136.9**	**134.6**	**129.3**	**128.8**	**122.0**
OUTPUT (Mtoe)	**32.2**	**47.1**	**47.1**	**47.5**	**49.4**	**51.4**	**52.2**
(TWh gross)	374.4	547.6	548.0	552.4	574.9	598.0	607.5
Output Shares (%)							
Coal	*69.0*	*58.8*	*53.4*	*54.2*	*51.9*	*50.5*	*53.4*
Oil	*12.0*	*1.9*	*1.3*	*1.2*	*0.8*	*0.8*	*0.7*
Gas	*10.9*	*7.4*	*9.2*	*9.8*	*9.8*	*14.5*	*18.6*
Comb. Renewables & Wastes	*0.8*	*0.9*	*1.3*	*1.6*	*2.2*	*2.7*	*2.9*
Nuclear	*3.2*	*27.8*	*31.1*	*29.3*	*29.5*	*25.1*	*17.3*
Hydro	*4.1*	*3.2*	*3.2*	*3.1*	*3.6*	*3.6*	*3.6*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	*0.0*	*0.6*	*0.8*	*2.2*	*2.9*	*3.5*
TOTAL LOSSES	**92.2**	**110.7**	**104.3**	**101.7**	**89.1**	**86.5**	**78.6**
of which:							
Electricity and Heat Generation[10]	60.0	83.4	80.7	77.8	71.4	69.3	62.0
Other Transformation	8.5	6.7	5.7	5.7	1.0	0.9	0.9
Own Use and Losses[11]	23.7	20.5	18.0	18.2	16.7	16.3	15.6
Statistical Differences	**–1.0**	**–1.5**	**–0.3**	**–0.4**	**1.9**	**2.2**	**2.5**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	1137.14	1640.06	1833.12	1883.53	2300.81	2590.48	..
Population (millions)	78.96	79.36	82.05	82.02	79.70	78.60	..
TPES/GDP[12]	0.30	0.22	0.19	0.18	0.15	0.14	..
Energy Production/TPES	0.51	0.52	0.40	0.38	0.36	0.33	0.30
Per Capita TPES[13]	4.28	4.48	4.23	4.20	4.40	4.46	..
Oil Supply/GDP[12]	0.14	0.08	0.08	0.07	0.06	0.05	..
TFC/GDP[12]	0.22	0.15	0.13	0.13	0.11	0.10	..
Per Capita TFC[13]	3.12	3.11	2.97	2.96	3.26	3.33	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	1073.5	981.4	884.0	876.1	857.6	860.7	861.3
CO_2 Emissions from Bunkers (Mt CO_2)	13.0	7.9	6.8	6.4	6.0	5.7	5.5

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	1.5	–0.3	–0.3	–0.8	0.3	–0.0	–0.5
Coal	–0.2	–0.6	–5.5	–2.8	–1.4	–0.6	–0.2
Oil	–0.1	–2.2	1.4	0.5	0.1	–0.1	–0.4
Gas	10.2	0.6	3.9	1.1	1.0	1.6	1.1
Comb. Renewables & Wastes	6.2	1.2	–1.1	6.2	9.8	1.3	1.2
Nuclear	27.5	10.3	1.6	–5.1	0.7	–2.4	–6.9
Hydro	3.2	–0.5	–0.1	–0.8	2.7	0.8	0.4
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	81.6	52.9	19.9	6.9	5.1
TFC	1.2	–0.7	–0.2	–0.0	1.0	0.1	–0.1
Electricity Consumption	3.8	1.4	0.2	1.0	1.0	0.8	0.5
Energy Production	1.0	0.2	–4.0	–5.9	–0.4	–1.8	–2.7
Net Oil Imports	0.2	–2.5	1.7	3.1	–0.1	–0.0	–0.3
GDP	2.4	2.1	1.6	2.8	2.9	2.4	–
Growth in the TPES/GDP Ratio	–0.8	–2.4	–1.9	–3.4	–2.6	–2.4	–
Growth in the TFC/GDP Ratio	–1.1	–2.7	–1.8	–2.7	–1.9	–2.2	–

Please note: Rounding may cause totals to differ from the sum of the elements.

GREECE

GENERAL ENERGY POLICY

Energy policy in Greece is developing in the context of an overall government policy of economic restructuring and of reducing the role of the state in the economy. At present, state-owned monopolies dominate the gas and electricity sectors. Past efforts to introduce partial privatisation of the electricity sector have yielded only minor results, but deregulation in the oil market in 1992 has resulted in the development of competition in the oil sector.

EU Directives on gas and electricity are stimulating reform efforts, together with the need for investment in the energy sector, including the need to improve cost-effective energy links with neighbouring countries to improve energy security.

Lignite, the only significant domestic energy resource, accounted for 70 per cent of electricity production in 1998. In the past, government policy favoured substituting lignite for imported oil, which accounted for 17.5 per cent of electricity production in 1998, but environmental concerns now favour the use of natural gas. Gas accounted for 2.7 per cent of total primary energy supply in 1998, and 3.7 per cent of electricity production.

ENERGY PRICES AND TAXATION

Energy prices are generally low by international standards. In 1998, electricity prices for industry were 24 per cent lower than the OECD Europe average. Uniform national tariffs allow substantial cross-subsidies between some (largely mainland) consumers, and isolated (largely island) consumers. Prices for motor vehicle fuels are also lower than the OECD Europe average and may be capped. Industrial and household fuel oil prices are considerably higher than the OECD Europe average, but the excise tax on diesel oil used for space heating is reduced during the heating season, October to April, from 83 000 to 6 100 Dr[1] per kilolitre. Natural gas prices for industrial customers are generally set in relation to fuel oil prices, but bulk purchasers can negotiate prices directly. The value added tax on natural gas was reduced from 18 per cent to 8 per cent from 1 January 1999.

ELECTRICITY

Several technical breakdowns affecting electricity supply over recent years have signalled the need to improve security and reliability of supply through investment

1. In 1999, on average, Dr 100 = $US 0.33. and Euro 0.30.

in the network. The growth in electricity demand on the islands, in particular, needs to be met with increased supply. Electricity prices are kept uniform and do not necessarily reflect the cost of supply.

The government raised electricity prices by 3 per cent in June 1998. In December 1999, legislation was passed (*Liberalisation of the Electricity Market*) with the aim to deregulate the electricity sector in line with the EU Electricity Directive.

Under the 1999 law, the Public Power Corporation (PPC) remains a vertically-integrated company with the exception of the management of the transmission system and dispatching generation units. PPC's legal monopoly in generation and supply was removed and the company was required to separate its accounts for its various activities. Provision was made for privatisation of up to 49 per cent of the company, and the flotation of PPC is being planned. Financial advisors have been appointed and a major restructuring of PPC is underway.

Conditions to supply liberalised consumers are set out in the legislation, but criteria defining liberalised customers will be set out in regulations.

The 1999 law requires the establishment of a System Operator by June 2000. The Greek Electricity Transmission System Operator S.A. will operate, manage, secure the maintenance and plan the development of the transmission system. It will also procure ancillary services. The company will be owned 51 per cent by the state and 49 per cent by the generators, initially only PPC.

The 1999 law also established a new organisation, the Regulatory Authority for Energy (RAE), to supervise the functioning of the deregulated market. RAE replaced the Board of Energy Planning and Control. The members of RAE were appointed in May 2000. RAE is mostly an advisory body to the Ministry of Development, with decision-making powers in the electricity sector.

Competition with PPC is expected to come initially from Hellenic Petroleum, which may construct a power plant at one of its refineries, and from Prometheus Gas, which has plans to build a power plant to export electricity and supply liberalised consumers. Other companies have indicated interest in entering the generation market. Electricity imports, at present only some 2 per cent of demand, are not expected to contribute to the development of competition, but could develop through interconnections with neighbouring countries. An interconnector with Italy is under construction and planned for commissioning in August 2001. An interconnector with Turkey is also under study, co-financed by the Trans-European Networks/Energy Programme of the European Commission. Auto-producers and CHP plants may also play a role in developing competition.

Recent projects to augment supply capacity include the following. A 492 MW gas-fired combined cycle power plant is being built at Komotini, in northern Greece, and is due to be completed in 2001. The plant is being built by a consortium led by ABB and is expected to meet about 10 per cent of national demand. Another consortium, also led by ABB, is constructing a 330 MW lignite-fired power plant at Meliti, also in northern Greece. A 150 MW power plant is being built on the island of Crete to help meet growth in demand of 7 per cent per year (compared with 3.5 per cent nationally). Additional capacity will be still be required to avoid peak shortages estimated in the order of 50-60 MW during the tourist season (June-September).

A memorandum of understanding was signed in September 1999 with neighbouring countries to promote the development of a competitive regional electricity market in south-eastern Europe.

GAS

Responsibility for developing the natural gas system rests with the state-owned Public Gas Corporation (DEPA). Until 1998, DEPA was owned by Hellenic Petroleum which retains rights to DEPA's share capital. In February 2000, Hellenic Petroleum increased its share in DEPA from 15 per cent to 35 per cent.

Demand for natural gas is expected to rise as new gas-fired electricity plants are constructed following the liberalisation of the electricity market in 2001. Greece is expected to follow the trend seen elsewhere in Europe with combined cycle gas plants forming the majority of new power plants because of lower investment costs and environmental advantages. Russia is expected to be the principal source of supply through the natural gas pipeline from Russia to Greece that was inaugurated in 1997. In February 2000, imports of Algerian LNG commenced.

On 16 September 1999, Prometheus Gas S.A. and ENEL (Italy) formed a new company, ENELCO S.A., to develop electric power projects in Greece. Prometheus Gas considers that the formation of the new company will lead to the development of new gas-fired power, to access to power plants in Italy through the interconnector, and to the support of Gazprom (Russia) as its representative for developing energy projects in the Balkans.

On 12 January 2000, Prometheus Gas, ENEL, Gama (Turkey), Gazprom and Exxon (US) signed an agreement for the construction and operation of a 400-600 MW gas-fired power plant in northern Greece. Electricity from the plant will be exported to neighbouring countries and sold to eligible customers following liberalisation of the electricity market.

Commercial and domestic substitution of gas for heating oil is impeded by the limited gas distribution network. Under a derogation from the EU for emerging markets, the government is not obliged to liberalise the gas sector until 2006. It is likely that considerable reform of the legal framework will be necessary before private investment in the gas network will take place and competition will develop. Nevertheless, it is expected that private investors will participate in regional supply companies to be established in Thessaloniki and Thessalia during 2000. Tenders from private investors were evaluated in May 2000. Tenders were also evaluated for private participation in the supply company for the Attiki area, but the procedure was inconclusive and is being repeated.

OIL

Oil accounted for 58.5 per cent of total primary energy supply in 1998, and the proportion may grow. There is one offshore oil field, Prinos, which provides less than 2.5 per cent of crude oil demand. At the end of 1998, Denison Mines of Canada left the North Aegean Petroleum Company and the oil field was returned to the state. At the end of 1999, agreement was reached for the Kavala Oil Company to continue development of the field.

In 1997, four exploration concessions were granted to two foreign consortiums in blocks along the Ionian coast, both onshore and offshore, and drilling activities are underway.

In 1998, the Public Petroleum Corporation was merged with DEP-EKY (responsible for hydrocarbons exploration and production), ELDA (the former Hellenic Aspropyrgos refinery), and the refining and chemicals activities of EKO (formerly Esso). The new company was renamed Hellenic Petroleum and transformed into a joint-stock company, of which 23 per cent was sold on the stock exchange. A second tranche was sold in 2000, but the state retains a majority shareholding.

In May 1999, Hellenic Petroleum announced a five-year development programme focused on investments in northern Greece, and specifically to further develop its industrial complex in Thessaloniki. Investment in the Thessaloniki complex will increase output of petrochemicals and will create capacity for producing automobile fuels meeting new EU environmental standards.

Also in 1999, a joint venture led by Hellenic Petroleum acquired majority holdings in FYROM's only oil refinery (the Okta Ad Skopje refinery near Skopje, the capital of FYROM) and in Global S.A., a petroleum marketing company in Albania. Hellenic Petroleum sees these acquisitions as a means of further developing markets in south-eastern Europe. The company has also begun construction of a 230 km pipeline to take oil from Thessaloniki to the Okta refinery. The pipeline will contribute to energy security in FYROM and possibly lead to opening of markets in Albania and Serbia. These developments are consistent with the government's policy to promote economic development generally in neighbouring countries.

RENEWABLE ENERGY

Wind power potential is substantial in Greece. Existing wind parks have a total capacity of 110 MW.

In 1997, Greece had the largest installed area of solar collectors in Europe. Total photovoltaic capacity is 22 kWp on small islands in the Aegean Sea. There is a target to increase capacity to 1 000 kWp by 2003. Geothermal capacity is estimated to allow the development of 200-300 MW of electricity generating capacity, and PPC is interested in exploiting the resource on the Aegean islands. Pilot biomass power plants are to be developed on the islands of Lesvos and Chios.

Two new hydro plants with a capacity of 100 MW each began operation on Nestor River in the Thissavros area in 1997. In 1998, two other hydro plants (Thissavro and Pouznari II) began operation with a total capacity of 132.4 MW (100 MW and 32.4 MW). From 1999 to 2003, new hydro plants with total installed capacity of about 323 MW are expected to start operation.

GREECE

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**2.33**	**8.80**	**9.64**	**9.89**	**9.59**	**12.00**	**..**
Coal[1]		1.69	7.12	7.71	8.13	8.09	10.36	..
Oil		..	0.85	0.48	0.32	–	–	..
Gas		–	0.14	0.05	0.04	–	–	..
Comb. Renewables & Wastes[2]		0.45	0.46	0.95	0.96	0.95	0.95	..
Nuclear		–	–	–	–	–	–	..
Hydro		0.19	0.15	0.33	0.32	0.39	0.40	..
Geothermal		–	0.00	0.00	0.00	0.00	0.11	..
Solar/Wind/Other[3]		–	0.08	0.12	0.12	0.16	0.18	..
TOTAL NET IMPORTS[4]		**11.12**	**13.01**	**16.33**	**17.91**	**26.93**	**32.50**	**..**
Coal[1]	Exports	0.02	–	0.04	0.05	–	–	..
	Imports	0.47	0.92	0.80	0.89	1.02	1.02	..
	Net Imports	0.45	0.92	0.76	0.85	1.02	1.02	..
Oil	Exports	4.95	7.59	3.88	3.29	6.00	6.00	..
	Imports	16.51	22.16	22.27	23.02	32.30	37.48	..
	Bunkers	0.89	2.55	3.15	3.50	3.50	3.50	..
	Net Imports	10.67	12.03	15.24	16.23	22.80	27.98	..
Gas	Exports	–	–	–	–	–	–	..
	Imports	–	–	0.13	0.69	2.96	3.50	..
	Net Imports	–	–	0.13	0.69	2.96	3.50	..
Electricity	Exports	0.00	0.05	0.06	0.08	0.10	–	..
	Imports	0.01	0.11	0.26	0.22	0.25	–	..
	Net Imports	0.00	0.06	0.20	0.14	0.15	–	..
TOTAL STOCK CHANGES		**–1.10**	**0.25**	**–0.32**	**–0.83**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**12.36**	**22.06**	**25.65**	**26.98**	**36.52**	**44.50**	**..**
Coal[1]		2.10	8.07	8.55	8.93	9.11	11.38	..
Oil		9.61	13.10	15.32	15.78	22.80	27.98	..
Gas		–	0.14	0.17	0.73	2.96	3.50	..
Comb. Renewables & Wastes[2]		0.45	0.46	0.95	0.96	0.95	0.95	..
Nuclear		–	–	–	–	–	–	..
Hydro		0.19	0.15	0.33	0.32	0.39	0.40	..
Geothermal		–	0.00	0.00	0.00	0.00	0.11	..
Solar/Wind/Other[3]		–	0.08	0.12	0.12	0.16	0.18	..
Electricity Trade[5]		0.00	0.06	0.20	0.14	0.15	–	..
Shares (%)								
Coal		*17.0*	*36.6*	*33.3*	*33.1*	*24.9*	*25.6*	..
Oil		*77.7*	*59.4*	*59.7*	*58.5*	*62.4*	*62.9*	..
Gas		–	*0.6*	*0.7*	*2.7*	*8.1*	*7.9*	..
Comb. Renewables & Wastes		*3.6*	*2.1*	*3.7*	*3.5*	*2.6*	*2.1*	..
Nuclear		–	–	–	–	–	–	..
Hydro		*1.5*	*0.7*	*1.3*	*1.2*	*1.1*	*0.9*	..
Geothermal		–	–	–	–	–	*0.2*	..
Solar/Wind/Other		–	*0.3*	*0.5*	*0.5*	*0.4*	*0.4*	..
Electricity Trade		–	*0.3*	*0.8*	*0.5*	*0.4*	–	..

0 is negligible, – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**9.21**	**15.05**	**18.04**	**19.08**	**27.12**	**33.05**	**..**
Coal[1]	0.52	1.20	0.94	0.95	1.02	1.02	..
Oil	7.15	10.75	12.76	13.36	19.22	24.44	..
Gas	0.00	0.11	0.09	0.34	1.45	1.72	..
Comb. Renewables & Wastes[2]	0.45	0.46	0.91	0.91	0.91	0.91	..
Geothermal	–	0.00	0.00	0.00	0.00	–	..
Solar/Wind/Other	–	0.08	0.12	0.12	0.12	0.12	..
Electricity	1.09	2.45	3.20	3.38	4.40	4.84	..
Heat	–	–	0.03	0.03	–	–	..
Shares (%)							
Coal	*5.6*	*8.0*	*5.2*	*5.0*	*3.8*	*3.1*	..
Oil	*77.6*	*71.4*	*70.7*	*70.0*	*70.9*	*73.9*	..
Gas	–	*0.7*	*0.5*	*1.8*	*5.3*	*5.2*	..
Comb. Renewables & Wastes	*4.9*	*3.1*	*5.0*	*4.8*	*3.4*	*2.8*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	*0.5*	*0.6*	*0.6*	*0.4*	*0.4*	..
Electricity	*11.9*	*16.3*	*17.7*	*17.7*	*16.2*	*14.6*	..
Heat	–	–	*0.1*	*0.1*	–	–	..
TOTAL INDUSTRY[6]	**3.49**	**4.62**	**4.86**	**5.07**	**6.86**	**8.18**	**..**
Coal[1]	0.46	1.18	0.91	0.92	1.00	1.00	..
Oil	2.39	2.18	2.60	2.51	3.21	4.41	..
Gas	–	0.10	0.08	0.33	1.02	1.02	..
Comb. Renewables & Wastes[2]	–	0.12	0.21	0.21	0.21	0.21	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	0.63	1.04	1.07	1.11	1.42	1.54	..
Heat	–	–	–	–	–	–	..
Shares (%)							
Coal	*13.1*	*25.4*	*18.7*	*18.1*	*14.6*	*12.2*	..
Oil	*68.7*	*47.2*	*53.4*	*49.5*	*46.8*	*53.9*	..
Gas	–	*2.2*	*1.6*	*6.5*	*14.9*	*12.5*	..
Comb. Renewables & Wastes	–	*2.6*	*4.3*	*4.0*	*3.1*	*2.6*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*18.2*	*22.5*	*22.0*	*21.9*	*20.7*	*18.8*	..
Heat	–	–	–	–	–	–	..
TRANSPORT[7]	**2.70**	**5.95**	**6.88**	**7.46**	**10.78**	**13.24**	**..**
TOTAL OTHER SECTORS[8]	**3.03**	**4.48**	**6.30**	**6.56**	**9.48**	**11.63**	**..**
Coal[1]	0.04	0.03	0.03	0.03	0.02	0.02	..
Oil	2.08	2.63	3.30	3.41	5.24	6.81	..
Gas	0.00	0.01	0.01	0.01	0.43	0.70	..
Comb. Renewables & Wastes[2]	0.45	0.34	0.70	0.70	0.70	0.70	..
Geothermal	–	0.00	0.00	0.00	0.00	–	..
Solar/Wind/Other	–	0.08	0.12	0.12	0.12	0.12	..
Electricity	0.46	1.40	2.12	2.26	2.97	3.28	..
Heat	–	–	0.03	0.03	–	–	..
Shares (%)							
Coal	*1.4*	*0.6*	*0.5*	*0.5*	*0.2*	*0.2*	..
Oil	*68.6*	*58.7*	*52.4*	*52.0*	*55.3*	*58.6*	..
Gas	*0.1*	*0.2*	*0.1*	*0.2*	*4.5*	*6.0*	..
Comb. Renewables & Wastes	*14.9*	*7.7*	*11.1*	*10.7*	*7.4*	*6.0*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	*1.7*	*1.8*	*1.8*	*1.3*	*1.0*	..
Electricity	*15.0*	*31.2*	*33.6*	*34.4*	*31.3*	*28.2*	..
Heat	–	–	*0.4*	*0.4*	–	–	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**3.34**	**8.90**	**9.97**	**10.57**	**12.45**	**15.10**	**..**
OUTPUT (Mtoe)	**1.27**	**2.99**	**3.72**	**3.97**	**4.73**	**5.76**	**..**
(TWh gross)	14.82	34.78	43.29	46.18	55.02	66.97	..
Output Shares (%)							
Coal	*35.5*	*72.4*	*70.7*	*70.3*	*55.3*	*60.5*	..
Oil	*49.5*	*22.3*	*19.2*	*17.5*	*19.4*	*15.8*	..
Gas	–	*0.3*	*0.8*	*3.7*	*16.2*	*15.4*	..
Comb. Renewables & Wastes	–	–	*0.3*	*0.3*	*0.2*	*0.2*	..
Nuclear	–	–	–	–	–	–	..
Hydro	*15.0*	*5.1*	*9.0*	*8.0*	*8.1*	*6.9*	..
Geothermal	–	–	–	–	–	*0.2*	..
Solar/Wind/Other	–	*0.0*	*0.1*	*0.2*	*0.8*	*1.0*	..
TOTAL LOSSES	**3.14**	**7.26**	**7.86**	**8.22**	**9.40**	**11.46**	**..**
of which:							
Electricity and Heat Generation[10]	2.07	5.91	6.22	6.57	7.43	9.35	..
Other Transformation	0.44	0.04	0.02	–0.01	0.21	0.22	..
Own Use and Losses[11]	0.64	1.31	1.63	1.66	1.76	1.89	..
Statistical Differences	**0.00**	**–0.26**	**–0.26**	**–0.33**	**–**	**–**	**–**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	55.87	82.91	93.42	96.72	127.28	154.86	..
Population (millions)	8.93	10.09	10.50	10.51	10.80	11.00	..
TPES/GDP[12]	0.22	0.27	0.27	0.28	0.29	0.29	..
Energy Production/TPES	0.19	0.40	0.38	0.37	0.26	0.27	..
Per Capita TPES[13]	1.38	2.19	2.44	2.57	3.38	4.05	..
Oil Supply/GDP[12]	0.17	0.16	0.16	0.16	0.18	0.18	..
TFC/GDP[12]	0.16	0.18	0.19	0.20	0.21	0.21	..
Per Capita TFC[13]	1.03	1.49	1.72	1.82	2.51	3.00	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	36.3	72.3	81.0	85.2	111.0	137.1	..
CO_2 Emissions from Bunkers (Mt CO_2)	2.7	8.0	9.9	11.1	11.1	11.1	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	4.4	2.9	2.2	5.2	4.4	4.0	–
Coal	8.7	8.0	0.8	4.4	0.3	4.6	–
Oil	3.5	0.9	2.3	3.0	5.4	4.2	–
Gas	–	–	3.1	324.0	22.3	3.4	–
Comb. Renewables & Wastes	–	0.3	10.8	0.3	–0.1	–	–
Nuclear	–	–	–	–	–	–	–
Hydro	8.2	–6.2	11.9	–4.2	2.7	0.8	–
Geothermal	–	–	10.4	–	10.4	94.0	–
Solar/Wind/Other	–	–	6.7	5.1	3.7	2.4	–
TFC	4.0	2.4	2.6	5.8	5.2	4.0	–
Electricity Consumption	7.0	3.7	3.9	5.7	3.8	1.9	–
Energy Production	8.3	8.0	1.3	2.7	–0.4	4.6	–
Net Oil Imports	2.5	–0.2	3.4	6.5	5.0	4.2	–
GDP	3.7	1.6	1.7	3.5	4.0	4.0	–
Growth in the TPES/GDP Ratio	0.7	1.3	0.5	1.6	0.4	0.0	–
Growth in the TFC/GDP Ratio	0.2	0.7	0.9	2.2	1.1	0.0	–

Please note: Rounding may cause totals to differ from the sum of the elements.

THE UNITED KINGDOM

MARKET REFORM

With the introduction of supply competition in electricity completed in May 1999, Great Britain became the first country in the world to offer all 26 million electricity and gas customers – industrial, commercial and domestic – the choice of which company supplies their energy.

In October 1998, the government published a White Paper *Conclusions of the Review of Energy Sources for Power Generation* and confirmed its intention to continue reform of the electricity sector. Specific measures included further divestment of coal-fired plant by the major generators and an overhaul of the electricity "Pool". While these reforms are in hand, restrictions have been placed on consents for new gas-fired power stations.

In October 1999, the Department of Trade and Industry and the Office of Gas and Electricity Markets (OFGEM) published proposed new arrangements for the wholesale trading of electricity, intended to bring more competition to the electricity market and downward pressure on prices.

Contracts have also been placed for the Northern Ireland – Scotland electricity interconnector.

In May 1999, OFGEM announced details of new gas trading arrangements for Great Britain to reflect the costs of balancing supply and demand on the national gas pipeline system. The reforms were introduced from 1 October 1999. A key feature of the opening phase of the new regime will be a screen-based on-the-day commodity market.

The gas interconnector between Bacton and Zeebrugge linking the UK and European gas grids was opened in October 1998.

The government is now enacting legislation to reform energy regulation. The measures include the separation of electricity supply from distribution, implementation of new electricity trading arrangements and a framework for encouraging renewable electricity generation and energy efficiency.

ENERGY AND ENVIRONMENT

Under the EU burden-sharing agreement, the UK's Kyoto target is to reduce greenhouse gas emissions by 12.5 per cent below 1990 levels by 2008-2012.

In March 2000, the government published a draft Climate Change Programme describing the UK's overall strategy to deliver its legally binding Kyoto target to cut greenhouse gas emissions below 1990 levels by 2008-2012, and to move towards its domestic goal of 20 per cent below 1990 levels by 2010. The package of measures includes ongoing policies such as the climate change levy, negotiated agreements with the energy-intensive sectors, voluntary agreements with car manufacturers to cut engine emissions, integrated transport policies, an obligation on suppliers to deliver 10 per cent of the UK's electricity from renewable sources by 2010, new funding for energy efficiency programmes, and a new target to double the capacity of combined heat and power by 2010.

Measures on renewables and energy efficiency are contained in the Utilities Bill. New energy efficiency standards of performance are expected to encourage greater investment in energy-saving measures. Utility companies will be expected to focus such investment on poorer households, helping them to heat their homes more efficiently and more economically.

Following consultation, the final Programme will be published in Autumn 2000.

Following the recommendations in Lord Marshall's report of November 1998 on the role of economic instruments and the business use of energy, the Chancellor announced in March 1999 the introduction of a climate change levy on business energy use which would come into force in April 2001. The aim of the levy is to encourage energy efficiency and to help the UK meet its Kyoto target for reducing greenhouse gas emissions. Electricity generated from "new" forms of renewable energy, such as solar and wind power, and by "good quality" combined heat and power plants will be exempted. The levy is expected to save at least two million tonnes of carbon.

The views of business have been taken into account in developing the levy and it has been designed to maximise environmental benefits while safeguarding competitiveness. Clauses implementing the climate change levy are included in the Finance Bill which received Royal Assent at the beginning of August 2000.

The government is supporting a business-led project to design a pilot emissions trading scheme (as recommended in Lord Marshall's report) which can stand alongside the climate change levy as a complementary means for businesses to contribute towards emissions reductions.

The government has been consulting during 1999 on revisions to the National Air Quality Strategy, which sets objectives for eight pollutants to be achieved by 2005. Included amongst these are targets for sulphur nitrogen dioxide and particulates from fossil fuel combustion.

OIL

In March 1999, improvements to the licensing process and some relaxation of information requirements for future licensing rounds, as well as a series of measures to increase licence trading, were announced. A more active market in licence interests is expected to lead to greater investment, as companies rationalise their portfolios. Streamlined regulation of oil and gas field developments was also announced.

North Sea Fiscal Review

In the March 1998 Budget two alternative fiscal reform packages were outlined, but a planned consultative document giving more details did not appear. The two packages were:

- the introduction of a supplementary corporation tax charge on the profits from UK oil and gas extraction activities; and
- broadening the scope of the Petroleum Revenue Tax (PRT) by extending it to all fields given development consent after 15 March 1993, halving the oil allowance, and introducing a new PRT relief to give companies relief on their abortive exploration expenditures.

Both of the proposed packages would have included the abolition of royalty on older oil and gas fields and the removal of Tariff Receipts Allowance, which reduces the PRT charge on tariffs. However, in view of falling oil prices it was decided in September 1998 not to proceed with consultation on the packages.

The main challenge for UK refiners in 1999 was the requirement to switch to manufacture of 2000 specification motor fuel products as agreed under the EU's Auto-Oil I programme. UK refineries are advanced in their plans to switch to 2000 specification production and all refineries are producing ultra-low sulphur diesel to 2005 specification sulphur limits of 50 ppm maximum, with the help of a government duty differential of 3 pence per litre.

The recent rise in crude oil prices brought higher retail petrol prices in the UK. From mid-March 1999 to mid-October 1999, the retail price of premium unleaded petrol increased from 66.5 pence per litre (p/l) to 73.9 p/l, an increase of 11 per cent.

Tax policy has made UK road transport fuels amongst the most expensive in Europe. Duty increases have been driven by a commitment to raise road fuel duties by an average of 6 per cent per year above inflation, the fuel duty escalator, in order to help reduce emissions of greenhouse gases and to improve local air quality. From November 1999, the level of fuel duties are to be set on a Budget-by-Budget basis, taking account of the government's economic and social objectives as well as its environmental commitments.

COAL

In October 1998 the government published a White Paper identifying distortions in the electricity generating market. The distortions appeared to operate against coal-fired generation. The government has embarked on policies to remedy these distortions, including introducing a new system of electricity trading arrangements, divestment of coal-fired power stations and efforts aimed at creating a level playing field across Europe. While this reform programme was underway, the government put in place restrictions on consents for new gas-fired power stations.

In parallel with these measures, the environmental impacts of coal were addressed by amendments to the regulatory regime for emissions of sulphur dioxide, and revised government guidance on land-use consents for new deep mine and open cast sites. Social and regional consequences of reduced production of coal have been addressed by a coalfield regeneration programme, involving expenditure of £354 million on restoration of mining sites, provision of workshops and training, and improvements to housing and social and communal facilities.

NUCLEAR

In a White Paper published in October 1998, the UK Government considered that nuclear power "makes a valuable contribution to diversity of supply and emissions reduction". However, the Paper also suggests that the cost of new construction means nuclear power's share of generation is expected to decrease in the first decades of the next century as existing capacity is retired. In the meantime, any proposals for nuclear construction are to be considered against the same objectives as those for power plants, i.e. the ability to ensure secure, diverse and sustainable supplies of energy at competitive prices.

The transfer of the government's shares in Magnox to British Nuclear Fuels Limited (BNFL) took place in 1998, and BNFL now owns and operates the UK's eight operating and three decommissioning Magnox nuclear power stations. In July 1999, the government announced it was considering partially privatising BNFL before the end of the current Parliament, and indicated a new direction for BNFL as a leading world player in nuclear clean-up and decommissioning work.

In March 1999, the House of Lords Select Committee on Science and Technology published the report of its enquiry into *The Management of Nuclear Waste*. Its principal recommendations support the principle of deep disposal in preference to long-term surface storage and propose a non-governmental nuclear waste management commission to oversee policy implementation. The report also recommends construction of a new radioactive waste disposal company which would construct, operate and close disposal facilities. The government replied to the report in October 1999 and plans to announce proposals in 2001.

In January 2000, the UK Atomic Energy Authority took over management responsibility for the Joint European Torus (JET). An agreement has been drawn up which will allow continued operation of this leading international fusion research facility for a further three years. All existing participants to the current JET organisation are expected to sign on to the new agreement before the end of the year.

RENEWABLE ENERGY

The government intends to work towards the aim of achieving 10 per cent of the UK's electricity supply from renewables by 2010. The downward trend in expenditure on the renewables research and development programme will be reversed, and expenditure is expected to rise from around £10 million currently to £18 million in 2001/2002.

In September 1998, the government announced the composition of the fifth and largest Renewables Order for England and Wales under the Non-fossil Fuel Obligation (NFFO). The NFFO makes arrangements for 1,177 MW of capacity from 261 new projects at an average price of power of 2.71 pence per kWh, the cheapest so far. In February 1999, a third Scottish NFFO Order was laid for 150 MW.

In March 1999, the government published a consultation document, *Prospects of New and Renewable Energy in the 21st Century*. An analysis of views on the UK's renewable energy strategy was published in July 1999, *New and Renewable Energy - Prospects for the 21st Century.* The government intends to publish an *Energy Paper* in 2000 setting out its policy and strategy.

In October 1999 the Fossil Fuel Levy, used to help fund renewable forms of power generation, was reduced from 0.7 per cent to 0.3 per cent of electricity bills.

RESEARCH, DEVELOPMENT AND DEMONSTRATION

In April 1999, *Energy Paper 67, Cleaner Coal Technologies: The Government's Plans for R&D, Technology Transfer and Export Promotion* was published, which set out details of a new policy on cleaner coal technology. It is planned that £12 million will be spent on cleaner coal technology over the first three years of the six-year programme. If the gearing ratio of 4:1 achieved over the last programme is maintained, this input would prime UK-based research and development activity in excess of £60 million.

In October 1998, a White Paper on the conclusions of the review of energy sources for power generation reported that a cleaner coal technology research and development programme would be maintained but a demonstration programme would not be supported. This paper will be reviewed in 2000.

Most of the future research and development effort is expected to focus on contributing to the recommendations of an industry-led Foresight Task Force covering advanced power generation technologies, since these are considered to offer the most potential to enhance the UK industry's future export activities. A limited amount of work is also expected on identifying innovative ways of exploiting UK coal reserves by non-mining methods and underground coal gasification in collaboration with the Coal Authority. The programme will contribute to a global strategy to contain the growth of carbon dioxide emissions in developing countries in collaboration with OECD countries.

THE UNITED KINGDOM

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**108.5**	**208.9**	**268.8**	**274.2**	**290.4**	**273.9**	**..**
Coal[1]		75.9	54.6	29.6	25.7	18.0	17.0	..
Oil		0.6	95.3	134.3	138.9	150.0	126.0	..
Gas		24.4	40.9	77.2	81.1	101.0	114.4	..
Comb. Renewables & Wastes[2]		–	0.6	1.7	1.9	1.3	1.3	..
Nuclear		7.3	17.1	25.6	26.1	19.7	14.8	..
Hydro		0.3	0.4	0.4	0.4	0.4	0.4	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	0.0	0.1	0.1	0.0	0.0	..
TOTAL NET IMPORTS[4]		**110.4**	**2.1**	**–38.8**	**–41.1**	**–45.1**	**–24.5**	**..**
Coal[1]	Exports	2.0	1.8	0.9	0.8	–	–	..
	Imports	1.1	10.3	13.8	15.1	17.7	10.5	..
	Net Imports	–0.9	8.5	12.9	14.3	17.7	10.5	..
Oil	Exports	20.9	76.5	110.2	113.1	123.3	95.5	..
	Imports	136.9	65.4	60.7	61.3	70.0	70.0	..
	Bunkers	5.4	2.5	2.9	3.1	2.0	2.0	..
	Net Imports	110.6	–13.6	–52.5	–54.9	–55.3	–27.5	..
Gas	Exports	–	–	1.7	2.4	19.0	19.0	..
	Imports	0.7	6.2	1.1	0.8	10.0	10.0	..
	Net Imports	0.7	6.2	–0.6	–1.6	–9.0	–9.0	..
Electricity	Exports	0.0	0.0	0.0	0.0	–	–	..
	Imports	0.0	1.0	1.4	1.1	1.5	1.5	..
	Net Imports	0.0	1.0	1.4	1.1	1.5	1.5	..
TOTAL STOCK CHANGES		**1.8**	**2.0**	**–2.6**	**–0.2**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**220.8**	**213.1**	**227.4**	**232.9**	**245.3**	**249.4**	**..**
Coal[1]		76.4	64.0	40.1	40.6	35.7	27.5	..
Oil		111.6	82.6	82.1	83.3	94.7	98.5	..
Gas		25.1	47.2	76.2	79.3	92.0	105.4	..
Comb. Renewables & Wastes[2]		–	0.6	1.7	1.9	1.3	1.3	..
Nuclear		7.3	17.1	25.6	26.1	19.7	14.8	..
Hydro		0.3	0.4	0.4	0.4	0.4	0.4	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	0.0	0.1	0.1	0.0	0.0	..
Electricity Trade[5]		0.0	1.0	1.4	1.1	1.5	1.5	..
Shares (%)								
Coal		*34.6*	*30.0*	*17.6*	*17.5*	*14.6*	*11.0*	..
Oil		*50.5*	*38.8*	*36.1*	*35.8*	*38.6*	*39.5*	..
Gas		*11.4*	*22.1*	*33.5*	*34.1*	*37.5*	*42.3*	..
Comb. Renewables & Wastes		–	*0.3*	*0.7*	*0.8*	*0.5*	*0.5*	..
Nuclear		*3.3*	*8.0*	*11.2*	*11.2*	*8.0*	*5.9*	..
Hydro		*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other		–	–	–	–	–	–	..
Electricity Trade		–	*0.5*	*0.6*	*0.5*	*0.6*	*0.6*	..

0 is negligible, – is nil, .. is not available.

Please note: Forecast data are based on the 1995 submission. Forecast data for production, imports, exports and bunkers of coal, oil and natural gas and forecast data for electricity generated are IEA Secretariat estimates.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**147.7**	**145.3**	**157.3**	**159.0**	**175.0**	**182.6**	**..**
Coal[1]	26.7	10.7	6.6	5.9	9.6	8.4	..
Oil	77.3	68.8	73.5	73.7	77.9	81.9	..
Gas	23.6	42.0	49.8	51.4	56.7	59.9	..
Comb. Renewables & Wastes[2]	–	0.2	0.8	0.8	0.2	0.2	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	20.0	23.6	26.6	27.1	30.6	32.2	..
Heat	–	0.0	–	–	–	–	..
Shares (%)							
Coal	*18.1*	*7.3*	*4.2*	*3.7*	*5.5*	*4.6*	..
Oil	*52.3*	*47.4*	*46.7*	*46.4*	*44.5*	*44.9*	..
Gas	*16.0*	*28.9*	*31.7*	*32.4*	*32.4*	*32.8*	..
Comb. Renewables & Wastes	–	*0.1*	*0.5*	*0.5*	*0.1*	*0.1*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*13.6*	*16.2*	*16.9*	*17.1*	*17.5*	*17.6*	..
Heat	–	–	–	–	–	–	..
TOTAL INDUSTRY[6]	**65.5**	**42.7**	**44.8**	**45.0**	**51.5**	**52.4**	**..**
Coal[1]	13.6	6.3	4.1	3.8	6.8	6.2	..
Oil	34.0	15.8	17.1	16.8	16.8	16.0	..
Gas	10.1	12.0	14.1	14.8	15.7	16.9	..
Comb. Renewables & Wastes[2]	–	0.0	0.4	0.4	0.1	0.1	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	7.8	8.7	9.0	9.1	12.2	13.2	..
Heat	–	0.0	–	–	–	–	..
Shares (%)							
Coal	*20.7*	*14.7*	*9.3*	*8.5*	*13.2*	*11.8*	..
Oil	*51.9*	*36.9*	*38.3*	*37.4*	*32.6*	*30.5*	..
Gas	*15.5*	*28.0*	*31.4*	*32.8*	*30.5*	*32.3*	..
Comb. Renewables & Wastes	–	–	*1.0*	*1.0*	*0.2*	*0.2*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*12.0*	*20.3*	*20.1*	*20.3*	*23.7*	*25.2*	..
Heat	–	–	–	–	–	–	..
TRANSPORT[7]	**31.0**	**46.5**	**50.6**	**51.1**	**58.6**	**63.9**	**..**
TOTAL OTHER SECTORS[8]	**51.2**	**56.2**	**61.9**	**62.8**	**64.8**	**66.2**	**..**
Coal[1]	13.1	4.4	2.5	2.1	2.8	2.2	..
Oil	12.6	7.0	6.4	6.4	2.9	2.4	..
Gas	13.5	30.0	35.8	36.7	41.0	43.0	..
Comb. Renewables & Wastes[2]	–	0.2	0.3	0.3	0.1	0.1	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	12.0	14.5	16.9	17.4	18.0	18.6	..
Heat	–	–	–	–	–	–	..
Shares (%)							
Coal	*25.5*	*7.8*	*4.0*	*3.3*	*4.3*	*3.3*	..
Oil	*24.7*	*12.5*	*10.4*	*10.1*	*4.5*	*3.6*	..
Gas	*26.4*	*53.5*	*57.8*	*58.4*	*63.3*	*65.0*	..
Comb. Renewables & Wastes	–	*0.4*	*0.5*	*0.5*	*0.2*	*0.2*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*23.4*	*25.8*	*27.3*	*27.7*	*27.8*	*28.1*	..
Heat	–	–	–	–	–	–	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**72.5**	**74.6**	**74.8**	**77.4**	**81.9**	**78.8**	**..**
OUTPUT (Mtoe)	**24.2**	**27.3**	**29.6**	**30.7**	**34.0**	**35.5**	**..**
(TWh gross)	281.4	317.0	343.9	356.6	395.3	412.8	..
Output Shares (%)							
Coal	*62.1*	*65.3*	*34.8*	*34.5*	*25.8*	*19.7*	..
Oil	*25.6*	*10.8*	*2.3*	*1.6*	*18.0*	*15.2*	..
Gas	*1.0*	*1.1*	*31.2*	*32.5*	*34.9*	*49.3*	..
Comb. Renewables & Wastes	–	*0.4*	*1.6*	*1.6*	*0.9*	*0.9*	..
Nuclear	*10.0*	*20.7*	*28.5*	*28.1*	*19.1*	*13.7*	..
Hydro	*1.4*	*1.6*	*1.2*	*1.5*	*1.2*	*1.1*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	*0.0*	*0.2*	*0.2*	*0.1*	*0.1*	..
TOTAL LOSSES	**72.2**	**68.5**	**68.1**	**69.7**	**70.4**	**66.9**	**..**
of which:							
Electricity and Heat Generation[10]	48.3	47.3	45.2	46.7	47.9	43.4	..
Other Transformation	7.2	5.1	4.3	4.0	1.0	0.8	..
Own Use and Losses[11]	16.7	16.1	18.6	19.0	21.5	22.7	..
Statistical Differences	**0.9**	**–0.8**	**2.1**	**4.2**	**–**	**–**	**..**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	698.05	975.51	1100.51	1123.21	1317.01	1475.59	..
Population (millions)	56.22	57.56	59.01	59.24	60.35	61.00	..
TPES/GDP[12]	0.32	0.22	0.21	0.21	0.19	0.17	..
Energy Production/TPES	0.49	0.98	1.18	1.18	1.18	1.10	..
Per Capita TPES[13]	3.93	3.70	3.85	3.93	4.07	4.09	..
Oil Supply/GDP12	0.16	0.08	0.07	0.07	0.07	0.07	..
TFC/GDP[12]	0.21	0.15	0.14	0.14	0.13	0.12	..
Per Capita TFC[13]	2.63	2.52	2.67	2.68	2.90	2.99	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	665.5	585.3	553.8	566.8	606.7	616.5	..
CO_2 Emissions from Bunkers (Mt CO_2)	17.0	7.9	9.2	9.6	6.3	6.3	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	–0.1	–0.3	0.9	2.4	0.7	0.3	..
Coal	–0.5	–1.3	–6.5	1.5	–1.8	–5.1	..
Oil	–2.7	–1.3	–0.1	1.5	1.8	0.8	..
Gas	8.3	1.4	7.1	4.1	2.1	2.8	..
Comb. Renewables & Wastes	–	–	15.1	13.0	–5.4	–	..
Nuclear	5.4	5.0	5.9	2.0	–3.9	–5.6	..
Hydro	1.6	1.8	–3.2	26.5	–1.6	–	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	78.2	33.3	–8.8	–	..
TFC	0.1	–0.2	1.1	1.1	1.4	0.9	..
Electricity Consumption	0.9	1.0	1.7	2.1	1.7	1.0	..
Energy Production	10.1	0.7	3.7	2.0	0.8	–1.2	..
Net Oil Imports	–27.1	–	21.3	4.5	0.1	–13.0	..
GDP	1.5	2.2	1.7	2.1	2.3	2.3	..
Growth in the TPES/GDP Ratio	–1.6	–2.5	–0.8	0.3	–1.5	–1.9	..
Growth in the TFC/GDP Ratio	–1.4	–2.4	–0.6	–1.0	–0.9	–1.4	..

Please note: Rounding may cause totals to differ from the sum of the elements.

THE UNITED STATES

GENERAL OVERVIEW

Energy policy in the United States is determined both at the level of individual states and at the federal level. Consequently, energy market and policy development yields a highly dynamic and complex picture, of which only the main features can be rendered in this review.

Developments in the US energy market over the past two years were dominated by the continuing process of introducing competition into the electricity and gas markets, mainly at the state level, some electricity price spikes and supply problems during the summer months, especially in California and the Western Interconnection, and the rapid increase of oil prices beginning in mid-1999.

CLIMATE CHANGE

The United States signed the Kyoto Protocol to the Climate Convention in November 1998, but has as yet not ratified it. The Kyoto Protocol calls for the United States to reduce its emissions of six greenhouse gases by 7 per cent on average during the years 2008 to 2012, compared with 1990 levels. As long as the Treaty is not ratified it is not considered legally binding. Nevertheless, the US government continues to seek ways of limiting the expected growth in greenhouse gas emissions.

In the US, approximately 90 per cent of greenhouse gas emissions from anthropogenic sources come from energy production and use. The energy-related emissions of CO_2 account for about 80-85 per cent of current US greenhouse gas emissions. Between 1990 and 1997, carbon emissions increased 10 per cent. By 2010, they are expected to rise 33 per cent over 1990 levels. US carbon emissions are about equally split between the transport, industry, and commercial/residential sectors.

Recent developments in the US response to climate change focus on government spending or tax breaks on research, development and accelerated market penetration of low-carbon or energy-efficient technology. The government's budget includes about $1.6 billion in fiscal year 2001 for tax incentives, research, development, deployment, and other spending for the Climate Change Technology Initiative (CCTI). CCTI includes tax incentives for deploying energy efficiency improvements and renewable technologies for buildings, light-duty vehicles, and electricity generation. The total 2001 CCTI budget request of about $1.6 billion for all Federal agencies includes about $1.4 billion for research, development and deployment, and $201 million for tax incentives in fiscal year 2001. Of the $1.4 billion in expenditures for programmes other than tax incentives, $337 million represents an increase over the fiscal year 2000 budget.

This and other funding covers research, development and deployment for a broad array of energy-efficient and renewable technologies and programmes, including appliance efficiency standards. One focus of these programmes is climate change; but they often have additional benefits for improved air quality due to reductions in pollutants, enhanced energy security, and for maintaining US leadership in science and technology. Although the tax incentives are largely new initiatives, many of the other programmes are continuations or expansions of ongoing research, development and deployment programmes. The Department of Energy also carries out long-term carbon sequestration research.

ENERGY EFFICIENCY

The US Department of Energy (DOE) has numerous initiatives in place to improve energy efficiency and to increase the use of renewable energies. It has developed specific sub-goals in these areas with a time horizon to 2010. With respect to energy efficiency, the DOE strives to:

- Reduce energy consumption in Federal facilities by 35 per cent relative to the 1985 consumption level, saving taxpayers $12 billion from 2000 to 2010.

- Increase the average fuel efficiency of new cars and light trucks by 20 per cent relative to the US Environmental Protection Agency's (EPA's) reference fuel efficiency level for 2010, saving 395 million barrels of oil in the time period from 2000 to 2010 and reducing carbon emissions by 33 million tonnes.

- Increase the average fuel efficiency of large trucks by 7 per cent relative to the 1998 efficiency level, saving 180 million barrels of oil between 2000 and 2010 and reducing carbon emissions by 20 million tonnes.

- Reduce industry energy consumption per dollar of output 25 per cent below its 1990 level, increasing the competitiveness of US industry by reducing cumulative industry energy costs by more than $30 billion between 2000 and 2010.

- Improve the energy efficiency of 25 per cent of the new building stock by 50 per cent, and the energy efficiency of 15 per cent of the existing building stock by 20 per cent, saving over $65 billion in cumulative building energy costs.

- Achieve $3 billion in annual export sales of energy efficiency technologies, creating about 100,000 jobs in the country.

The government strives to realise these objectives using a wide array of mechanisms to promote the use of energy-efficient technology. Support to research and development projects is considered as particularly important, but many other mechanisms are also in use. These include energy efficiency legislation and standards, attempts to overcome institutional barriers to energy efficiency, e.g. through the development of new insurance practices, and financial assistance, in some cases with the contribution of third parties such as the banking and insurance industries.

One example of a recent achievement is the ballast energy efficiency standard agreement reached in 1999. This is an agreement between DOE, lamp ballast manufacturers, and energy efficiency advocates to improve the energy efficiency of fluorescent lighting in commercial and industrial applications. Adoption of the efficiency standard is expected to yield energy savings over a 30-year period equivalent to the amount of energy needed to supply 12 to 26 million homes in the United States for one year.

Another example is the network of DOE's Industrial Assessment Centers. These centres help firms save millions of dollars in energy costs. Working through 30 universities, this deployment programme has provided more than 7,600 energy and industrial process audits as of 1998 to small and mid-size manufacturing firms, generating recommendations that could save participating firms $300 million in 2000. Clean Cities-Government/industry partnerships formed through the Clean Cities programme have helped deploy 139,000 alternatively-fuelled vehicles over the last five years, reducing gasoline and diesel fuel use by an estimated 380 million gallons through 1998 and reducing carbon emissions by an estimated 660,000 tonnes.

OIL

The US oil market was affected by the volatility in oil prices over the past several years. In 1997, the simultaneous increase in oil production by the Organisation of Petroleum Exporting Countries (OPEC) and the decline in demand following the recession in Asia led oil prices to fall to the historic low of $10 per barrel. As of spring 1998, oil producers cut production in response, just as world oil demand began increasing again. The result of these interventions was that oil stocks were drawn down rapidly world-wide and spot market prices in the US surged from $12 in February 1999 to $34 in the first week of March 2000. In particular, the US north-east experienced low inventories and tight supplies of heating oil and diesel, due to cold weather, local supply problems and low oil product stocks. This resulted in price spikes in January 2000. The gasoline market also became very tight.

The US government's response to this situation involved numerous discussions of the US Energy Secretary with oil producing nations; this diplomatic effort lasted several months. Despite these efforts, crude oil prices remained high throughout the summer despite initial announcements of production increases.

The government has a number of mitigation measures in place. Longer-term policies include co-operation with oil consuming and producing nations though the IEA, maintaining the US Strategic Petroleum Reserve (SPR), delaying the decline of domestic oil production, expanding exploration, improving exploration and production technology, and lending increased support to diversification of energy supplies and energy efficiency. These policies have been in place for a number of years in an attempt to counteract the long-term declining trend in US oil production. For example, the government has several programmes in place to assist continued production from wells that are about to be abandoned. Its objective is to halt the decline in domestic extraction rates by around 2005. The recent price volatility has made this objective harder to achieve. The price drop in 1998 caused a fall in domestic production of 250,000 barrels per day, scrapping of rigs and a 10 per cent drop in employment in the industry. Only a part of the lost production has come back with increasing prices. In March 2000, the government announced its intention to step up the efforts in these areas through a tax incentive programme.

Shorter-term measures comprised establishing a regional heating oil reserve, increasing funding for an existing support programme for low-income families, additional monies for building insulation programmes, and delayed oil deliveries to the Strategic Petroleum Reserve (SPR).

On 11 February 1999, the Department of Energy had announced plans to restore the Strategic Petroleum Reserve to 1996 levels with federal royalty oil from production in the Gulf of Mexico. It is the government's objective to replace approximately 28 million barrels of oil (approximately 5 per cent of the total reserve) that had been sold in 1996 to reduce the federal budget deficit. By the end of October 2000, the DOE will have taken title to all 28 million barrels and exchanged it for oil to be delivered to the SPR sites. Approximately 11 million barrels have already been delivered. The DOE has renegotiated the delivery dates for the remaining oil into 2001 in order to avoid removing oil from a tight market. In September 2000, the government decided to exchange 30 million barrels of oil from the reserve for the future delivery of larger quantities to be delivered a year later.

On 10 July 2000, the Energy Secretary was instructed to establish a regional reserve of heating oil for the north-east. In August, the Department of Energy contracted for 2 million barrels of heating oil and storage capacity for a year beginning on 1 October 2000 with the option of extending the storage contracts for a second year. One million barrels of the capacity is in New York harbour and the other is in New Haven, Connecticut. The delivery of the heating oil was completed on 14 October.

NATURAL GAS

Following the gradual introduction of competition into the natural gas wholesale markets in the 1980s, US gas prices have declined, gas demand has increased, and the interstate pipeline system has become a flexible national grid.

Natural gas supplies roughly 25 per cent of US energy needs. The industrial sector accounts for about 40 per cent of end-use consumption in the US, and industrial firms were among the first to seek cheaper gas supplies from marketers and other alternative gas providers. In the residential and commercial sector, customers are increasingly being allowed by state regulators to choose their gas suppliers, and expanding distribution networks have brought natural gas to areas where it previously was unavailable.

Natural gas is now the most economic choice in many applications. It also offers important energy security and environmental benefits. Assuring adequate supplies of natural gas and encouraging the development of new technologies to further expand the use of natural gas in all sectors has been a priority of the government.

Nearly all anticipated near-term capacity additions for electricity generation will be gas-fired. This is due to the favourable economics of gas-fired power generation capacity, and in particular to their low capacity cost, small size and short lead times.

In the last 18 months, rising oil prices, continued strong economic growth and high gas utilisation in incremental power supply have resulted in rising natural gas prices. Gas prices rose significantly during spring and summer 2000, and the DOE's Energy Information Administration (EIA) estimates that average natural gas wellhead prices this coming winter are likely to be nearly double the level seen last year. This development would generate an average increase in the unit cost of gas delivered to residential consumers of about 25 per cent.

Electric utility demand for natural gas usually peaks during the summer with the summer air conditioning load. In the summer 2000, the increase was more pronounced. The reasons for this were expectations of a particularly hot summer, a larger share of power generation using natural gas, especially with the expected addition of some new merchant power plants in June, and lower gas inventories than in 1999, providing less coverage as measured in days of supply.

While natural gas imports have risen significantly in recent years, there are some short-term supply constraints. Several years of relatively low prices have slowed down exploration and drilling for new sources of supply. The recent higher prices have caused exploration and drilling to rebound, but additional supplies are not likely to expand production quickly in any significant way. In fact, the gap between crude oil prices and gas prices has widened recently. Hence, even in the light of higher gas prices, the Energy Information Administration projects that the volume of gas used for electricity generation will more than double by 2020, due to its favourable overall economics.

The Department of Energy works with industry, other government agencies and the research community to develop information, policies and technologies to ensure gas supply and realise the environmental, economic and energy security benefits of natural gas use. The Department's natural gas supply programme is supporting the development of technologies to improve the efficiency of gas recovery and to expand gas supply by reducing exploration risks and uncertainties, by reducing recovery costs and by making new sources of natural gas more accessible. The natural gas infrastructure programme supports gas delivery technologies that improve the existing infrastructure, accelerates the construction of new infrastructure and protects critical infrastructure from natural and human threats. Finally, the natural gas utilisation programme supports technologies, such as fuel cells and advanced micro-turbines, that provide more efficient and environmentally superior ways to use natural gas.

Encouraging the increased use of natural gas and other oil substitutes in the transportation sector is perhaps the greatest challenge for the Department.

Compressed natural gas vehicles have successfully been introduced into numerous vehicle fleets. Vehicle fuel cells powered by natural gas, also under development, may enable larger-scale uses in the future.

ELECTRICITY

Regulatory reform in the US power industry has been under way for a number of years. A major milestone was the issuance in April 1996 of Orders 888 and 889 by the Federal Energy Regulatory Commission (FERC) establishing competition in wholesale power markets. FERC does not have legal powers to stipulate vertical separation of utilities; hence, Orders 888 and 889 contained measures to ensure free and open access to the grids of vertically-integrated power utilities. According to these two Orders, utilities had to:

- File with FERC non-discriminatory transmission tariffs containing terms and conditions for grid access.

- Apply these transmission tariffs and conditions to their own wholesale electricity sales and purchases.

- Develop and maintain a real-time information system that gives all users the same access to transmission information that the incumbent utility enjoys.

- Separate the transmission function from generation and marketing.

Simultaneously, there was action to introduce competition in a number of US states – either in the form of state legislation, or in the form of legislative process, regulatory action, or pilot programmes. It became clear relatively rapidly that states were adopting different models of competition, and that the full benefits of a nation-wide competitive electricity market could only be reaped if federal legislation was enacted.

In December 1999, some 25 legislative proposals for federal electricity legislation were pending before Congress. Although the proposals differ in their exact detail, the leading proposals are broadly similar in content, and similar also to the Federal Government's own proposal. Most proposals aim to repeal and replace two pieces of legislation that have shaped the electricity supply industry in the US for decades: the 1978 Public Utility Regulatory Policies Act (PURPA) and the 1935 Public Utility Holding Company Act (PUHCA).

One of the reasons PURPA was enacted in the late 1970s was to allow certain non-utility electricity generators to sell their electricity to utilities at their avoided cost. This was meant to support the use of renewables and cogeneration in order to reduce dependence on foreign oil. PUHCA, which was enacted decades earlier, was aimed at breaking up the unconstrained and very large trusts that controlled the power and gas industry in the first decades of the century. Before PUHCA was adopted, three very large interstate holding companies controlled nearly half of all power generation in the US, and more than 100 other holding companies existed. They were found to have abused their vast market power, significantly raising electricity prices to final consumers. Under PUHCA, which limited the possibility to own power generation facilities in more than one state, these trusts were broken down into smaller entities. The end result of this was that electric utilities became single integrated utilities serving a circumscribed geographical area. However, the provisions of PUHCA limit the possibility of nation-wide competitive trade among utilities and non-utilities. For this reason, reform is necessary.

Prospects for adoption of federal legislation on competition in the power market are improving, although its timing and the scope of the issues to be addressed are still unclear. The proposed legislation has generally featured a reliability provision to address the operational security of the electric transmission system. At least four of the proposals include a provision for the establishment of an independent self-regulating reliability organisation to set and enforce mandatory reliability standards for the wholesale power system with FERC oversight.

However, comprehensive power market legislation will not be enacted in 2000, with Congressional adjournment (targeted for 6 October), the November elections and no significant progress. On the other hand, there is increasing interest in stand-alone legislation on power system reliability. The Senate has passed a version of such reliability legislation.

The Federal Government's proposal for introducing retail competition into the US electricity market contains the following key provisions.

- The Federal Government would encourage the states to implement retail competition by giving them a flexible mandate to do so. This means that all electricity consumers would be allowed to choose their supplier by 1 January 2003. But states or non-regulated (publicly-owned) utilities would be given the possibility to opt out of the competition mandate if they find, on the basis of a public proceeding, that an alternative, state-crafted retail competition plan, or even continuation of the current monopoly system, serve their consumers better. It would nevertheless work towards a convergence in the market, as it would institute a reciprocity clause that states with full retail competition could invoke, if necessary, against those states that retain monopoly structures.

- Non-discriminatory access to the transmission system would be facilitated, because the FERC would be given the authority to require the establishment of independent regional system operators (ISOs) that would manage the transmission grid on a day-to-day basis. FERC could then oblige transmission-owning utilities to transfer control of the grid to the ISO. Network reliability would be ensured through a successor organisation to the North American Electric Reliability Council (NERC) to be approved by FERC.

- The exact delineation of regulatory authority between FERC and the state regulatory commissions would be clarified by the new Law, since it would give

FERC clear authority over unbundled retail transmission within states. At present, FERC's authority is limited to wholesale transmission across state boundaries only. The Law would extend the validity of open grid access to publicly-owned utilities, such as the Tennessee Valley Authority (TVA) or the Bonneville Power Administration (BPA). It would ensure equal treatment of publicly-owned utilities and privately-owned utilities, whereas at present, publicly-owned utilities, especially municipal power utilities and co-operatives are exempt from certain taxes.

- Under the proposed legislation, FERC would be given the power to remedy market power in the wholesale market. The cumbersome provisions of PUHCA would be repealed, especially those restricting interstate trade, but FERC and the state regulatory commissions would be given expanded information disclosure rights to help guard against abuses by holding companies. FERC's jurisdiction over mergers would be extended to cover not only fully integrated utilities, which is the case now, but also electric utility holdings and generation-only companies. FERC would be given the authority to order divestiture of assets. Upon request from individual states, FERC could also address market power in the state retail market.

FERC has already taken action out of its own powers that go some way towards these proposals. On 19 May 1999, FERC issued a Note of Proposed Rulemaking on Regional Transmission Organisations (RTOs) that requires all transmission-owning utilities to put their networks under the control of RTOs by 15 December 2001. These Regional Transmission Organisations are to be independent from market participants. To ensure this, as well as coverage of the entire national territory by these organisations, RTOs are to be responsible for regions that are comparatively large, i.e. larger than the supply area of any single incumbent utility. RTOs are given extensive rights with respect to the operation of the transmission grid, including:

- Maintaining the short-term reliability of power supply in the region.

- Offering dispatch services for generating plants on the basis of marginal cost pricing.

- Planning and co-ordinating necessary transmission upgrades as well as administering an efficient transmission pricing system that creates the right incentives for grid extension and investment in power generating facilities.

- Calculating available transmission capacity as well as creating market mechanisms to manage transmission congestion.

- Serving as a supplier of last resort for ancillary services.

The introduction of competition to the US power market has already been beneficial for consumers. Industrial consumers in particular have benefited from price reductions. Some 60 GW, amounting to 7.5 per cent of generating capacity in the US, had been sold or was in the process of being divested by July 1999, on average at about twice its book value. Merger and acquisition activity continued at the quick pace recorded in previous years. This included both domestic mergers as well as the acquisition of two major utilities, PacifiCorp by ScottishPower and the New England Electric System, by the UK National Grid Group. These were the first-ever acquisition of US electricity companies by foreign utility investors.

RENEWABLES

The Unites States Government has developed concrete goals for the use of renewables over the next decade. By 2010 (unless mentioned otherwise), the government seeks to:

- Triple domestic use of bio-based products and bio-energy from 1999 levels. This could lead to the creation of as much as $20 billion a year in new income for farmers and rural communities.

- Increase non-hydroelectric renewable energy generating capacity to 25,000 MW to provide clean power for approximately 14 million households, and maintain the current level of US hydropower capacity by developing hydro technologies that are more “fish friendly”.

- Double the capacity of combined heat and power systems in the United States from the 1999 level to make use of thermal energy normally wasted.

- By 2005, increase the use of dedicated Alternative Fuel Vehicles from 400,000 operating in 1998 to 1.5 million, thereby displacing at least 130,000 barrels per day of petroleum use.

In recent years, renewables policy focused on the new electricity legislation, as the use of renewables is, in almost all cases, easiest and cheapest in the form of electricity (except for solar thermal in some regions). The electricity legislation, outlined in the preceding section, calls for repeal of section 210 of PURPA that requires utilities to purchase certain renewables at above market prices. Instead, it would introduce a portfolio standard for renewables that requires 7.5 per cent of all electricity sold in 2010 to originate from renewables. This, and other public benefits[1] such as energy efficiency programmes, low-income assistance, and consumer education, would be financed through a non-bypassable federal wires charge that is estimated to yield $6 billion a year.

There are also many renewables initiatives that are not directly related to electricity reform legislation. One noteworthy policy is the Department of Energy’s initiative “Wind Powering America”, announced in June 1999. The objective of this plan is to

1. “Public benefits” is the American equivalent of the European notion of “public service”.

increase the share of wind energy in total electricity generation to 5 per cent or more by 2020. This corresponds to a total capacity of 80 GW of wind energy. A complementary goal is to increase the number of states that have 20 MW or more of wind power in place to 24 by 2010, and to increase the Federal Government's own consumption of wind-based electricity to 5 per cent. In 1999, about one GW was added to US generating capacity, as producers rushed to make use of the expiring 1.5 cent/kWh federal tax credit for wind power. The government sought to extend the tax credit, but Congress did not authorise it.

NUCLEAR

Nuclear energy is responsible for approximately 20 per cent of the electricity generated in the US. The US Government has recently renewed its commitment to nuclear power with new technology programmes. The Nuclear Energy Research Initiative (NERI) and the Nuclear Energy Plant Optimisation (NEPO) programme aim at maintaining the existing fleet of operating reactors and preparing the technology base for the next generation of reactors.

Under the 1982 Nuclear Waste Policy Act (NWPA), the Federal Government has the responsibility to create a disposal site for spent nuclear fuel at commercial power plants and for other high-level radioactive waste. Under the Act, electricity consumers who were beneficiaries of nuclear-generated electricity had to pay a surcharge on their electricity bill to nuclear utilities. The utilities would forward the revenues from this surcharge to the Nuclear Waste Fund to finance the disposal site. DOE was charged with the responsibility of establishing the repository. Shipment of waste from 77 sites in 35 states was to begin by 31 January 1998.

A 1987 amendment to the NWPA designated a single site for the repository at Yucca Mountain on a DOE-controlled test site in the desert of southern Nevada. The selection of this site was subject to vigorous controversy, mainly for environmental and health reasons. The US Government does not expect to be able to accept waste shipments before 2010 at the earliest. As a consequence, nuclear operators had to expand on-site interim storage at their power plants. Many utilities faced additional costs from this, and some of them are approaching the point of running out of storage space, jeopardising their continued operation. The utilities sued the government with damage claims.

In 1999, the Secretary of Energy attempted to break the impasse between nuclear operators and the DOE with a draft bill that would have transferred the responsibility for the waste at its current location to DOE until it was eventually moved to the repository. The proposal also addressed the responsibility for developing the radiation standard used for the assessment of the site. In early 2000, the bill was adopted by the Senate, but received a veto from the President, with the effect that it cannot come into force.

In July 2000, another solution was found to address the cost overruns the missing repository has created with nuclear operators. The Energy Secretary signed an agreement with one company that allows this firm to deduct the extra cost from its future payments into the Nuclear Waste Fund. The government hopes that this will open a path to settlement of the lawsuits, which is needed for adoption of the compromise bill. It intends to conclude such agreements one by one with all nuclear generators.

TECHNOLOGY

In August 1999, the President's Committee of Advisors on Science and Technology (PCAST) proposed a tripling in the funding for international energy co-operation, amounting to an additional $500 million by 2005. About half of the funding is to be used to build stronger foundations for international co-operation in technology innovation, including training for energy analysts and managers, energy sector reforms, and funds for technical assistance in the framework of multilateral development banks. Approximately one-quarter would be used to support innovative end use technologies for building vehicles, factories and for cogeneration. The long-term goal of these programmes is to increase the contribution of renewables to world energy supply to the levels that fossil fuels reach today, and to develop decarbonisation and carbon sequestration technologies to allow the economic use of fossil fuels without greenhouse and air pollutant emissions.

THE UNITED STATES

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**1455**	**1649**	**1686**	**1695**	**1734**	**1802**	**1857**
Coal[1]		333	539	561	570	622	632	644
Oil		534	431	397	385	331	329	338
Gas		503	419	442	440	470	535	596
Comb. Renewables & Wastes[2]		37	62	71	76	83	89	93
Nuclear		23	159	174	186	186	173	141
Hydro		23	23	28	25	26	26	26
Geothermal		2	14	13	13	14	16	18
Solar/Wind/Other[3]		–	0	0	0	1	1	1
TOTAL NET IMPORTS[4]		**289**	**316**	**486**	**524**	**719**	**793**	**865**
Coal[1]	Exports	31	67	52	49	38	39	34
	Imports	1	2	6	7	13	15	17
	Net Imports	–30	–65	–46	–41	–25	–24	–18
Oil	Exports	11	39	49	46	45	46	45
	Imports	316	415	536	562	705	776	837
	Bunkers	9	29	23	23	19	22	26
	Net Imports	296	347	464	494	641	708	766
Gas	Exports	2	2	4	4	5	7	8
	Imports	24	35	69	73	105	113	123
	Net Imports	22	33	66	69	99	107	115
Electricity	Exports	0	2	1	1	2	2	1
	Imports	1	2	4	3	5	4	3
	Net Imports	1	0	3	2	4	2	2
TOTAL STOCK CHANGES		**–8**	**–39**	**9**	**–38**	**1**	**0**	**1**
TOTAL SUPPLY (TPES)		**1736**	**1926**	**2181**	**2182**	**2453**	**2595**	**2723**
Coal[1]		311	457	529	514	598	609	627
Oil		824	770	855	869	972	1037	1104
Gas		515	439	508	496	569	641	710
Comb. Renewables & Wastes[2]		37	62	71	76	83	89	93
Nuclear		23	159	174	186	186	173	141
Hydro		23	23	28	25	26	26	26
Geothermal		2	14	13	13	14	16	18
Solar/Wind/Other[3]		–	0	0	0	1	1	1
Electricity Trade[5]		1	0	3	2	4	2	2
Shares (%)								
Coal		*17.9*	*23.7*	*24.3*	*23.6*	*24.4*	*23.4*	*23.0*
Oil		*47.5*	*40.0*	*39.2*	*39.8*	*39.6*	*40.0*	*40.5*
Gas		*29.6*	*22.8*	*23.3*	*22.7*	*23.2*	*24.7*	*26.1*
Comb. Renewables & Wastes		*2.2*	*3.2*	*3.2*	*3.5*	*3.4*	*3.4*	*3.4*
Nuclear		*1.3*	*8.3*	*8.0*	*8.5*	*7.6*	*6.7*	*5.2*
Hydro		*1.3*	*1.2*	*1.3*	*1.2*	*1.1*	*1.0*	*1.0*
Geothermal		*0.1*	*0.7*	*0.6*	*0.6*	*0.6*	*0.6*	*0.7*
Solar/Wind/Other		–	–	–	–	–	–	–
Electricity Trade		*0.1*	–	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*

0 is negligible, – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**1246**	**1283**	**1438**	**1430**	**1656**	**1765**	**1874**
Coal[1]	44	31	29	29	45	45	45
Oil	701	698	772	777	901	971	1038
Gas	341	303	331	307	348	364	382
Comb. Renewables & Wastes[2]	16	23	26	29	51	52	54
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	143	226	273	280	310	333	354
Heat	–	2	8	8	..	..	..
Shares (%)							
Coal	*3.5*	*2.4*	*2.0*	*2.1*	*2.7*	*2.6*	*2.4*
Oil	*56.3*	*54.4*	*53.6*	*54.4*	*54.4*	*55.0*	*55.4*
Gas	*27.4*	*23.6*	*23.0*	*21.5*	*21.0*	*20.6*	*20.4*
Comb. Renewables & Wastes	*1.3*	*1.8*	*1.8*	*2.0*	*3.1*	*3.0*	*2.9*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*11.5*	*17.7*	*19.0*	*19.6*	*18.7*	*18.9*	*18.9*
Heat	–	*0.1*	*0.5*	*0.5*	..	..	..
TOTAL INDUSTRY[6]	**406**	**378**	**418**	**410**	**497**	**518**	**549**
Coal[1]	31	22	25	26	44	44	44
Oil	161	149	160	155	186	199	212
Gas	151	124	123	116	136	140	148
Comb. Renewables & Wastes[2]	7	9	13	15	34	35	35
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	56	75	92	93	96	101	109
Heat	–	–	5	5	..	..	..
Shares (%)							
Coal	*7.5*	*5.9*	*6.0*	*6.3*	*8.9*	*8.5*	*8.0*
Oil	*39.7*	*39.3*	*38.3*	*37.8*	*37.5*	*38.3*	*38.6*
Gas	*37.3*	*32.7*	*29.3*	*28.3*	*27.5*	*26.9*	*27.1*
Comb. Renewables & Wastes	*1.8*	*2.4*	*3.2*	*3.5*	*6.9*	*6.7*	*6.5*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*13.7*	*19.7*	*22.0*	*22.6*	*19.2*	*19.6*	*19.9*
Heat	–	–	*1.3*	*1.3*	..	..	..
TRANSPORT[7]	**420**	**502**	**569**	**582**	**697**	**760**	**820**
TOTAL OTHER SECTORS[8]	**420**	**402**	**451**	**437**	**463**	**486**	**504**
Coal[1]	14	9	4	3	1	1	1
Oil	137	63	62	57	46	45	43
Gas	173	164	191	176	190	199	205
Comb. Renewables & Wastes[2]	9	14	11	13	13	13	13
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	87	152	181	187	212	228	241
Heat	–	2	2	2	..	..	..
Shares (%)							
Coal	*3.2*	*2.2*	*0.9*	*0.8*	*0.3*	*0.3*	*0.3*
Oil	*32.6*	*15.6*	*13.7*	*13.0*	*9.9*	*9.2*	*8.6*
Gas	*41.2*	*40.7*	*42.3*	*40.2*	*41.1*	*40.9*	*40.7*
Comb. Renewables & Wastes	*2.1*	*3.4*	*2.5*	*2.9*	*2.8*	*2.7*	*2.6*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*20.8*	*37.7*	*40.1*	*42.6*	*45.9*	*47.0*	*47.9*
Heat	–	*0.4*	*0.5*	*0.5*	..	..	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**507**	**765**	**902**	**939**	**1002**	**1055**	**1092**
OUTPUT (Mtoe)	**169**	**274**	**316**	**327**	**352**	**376**	**400**
(TWh gross)	1966	3182	3670	3804	4091	4369	4649
Output Shares (%)							
Coal	*46.2*	*53.4*	*53.8*	*52.7*	*51.5*	*48.6*	*47.5*
Oil	*17.1*	*4.1*	*2.9*	*3.9*	*1.8*	*1.3*	*1.1*
Gas	*18.6*	*12.0*	*13.8*	*14.7*	*18.6*	*24.4*	*29.7*
Comb. Renewables & Wastes	*0.0*	*2.1*	*1.7*	*1.7*	*2.6*	*2.8*	*2.7*
Nuclear	*4.5*	*19.2*	*18.2*	*18.8*	*17.5*	*15.2*	*11.6*
Hydro	*13.5*	*8.6*	*9.0*	*7.7*	*7.4*	*7.0*	*6.5*
Geothermal	*0.1*	*0.5*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*
Solar/Wind/Other	*–*	*0.1*	*0.1*	*0.1*	*0.2*	*0.3*	*0.3*
TOTAL LOSSES	**498**	**651**	**734**	**764**	**797**	**830**	**849**
of which:							
Electricity and Heat Generation[10]	338	489	576	602	650	680	692
Other Transformation	–1	15	10	9	1	1	2
Own Use and Losses[11]	160	147	148	152	146	149	155
Statistical Differences	**–7**	**–9**	**8**	**–12**	**–**	**–**	**–**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	3701.40	5554.10	6780.50	7043.64	8447.29	9376.89	10398.60
Population (millions)	211.91	249.91	266.79	269.09	286.57	298.34	310.78
TPES/GDP[12]	0.47	0.35	0.32	0.31	0.29	0.28	0.26
Energy Production/TPES	0.84	0.86	0.77	0.78	0.71	0.69	0.68
Per Capita TPES[13]	8.19	7.70	8.17	8.11	8.56	8.70	8.76
Oil Supply/GDP[12]	0.22	0.14	0.13	0.12	0.12	0.11	0.11
TFC/GDP[12]	0.34	0.23	0.21	0.20	0.20	0.19	0.18
Per Capita TFC[13]	5.88	5.13	5.39	5.31	5.78	5.92	6.03
Energy-related CO_2 Emissions (Mt CO_2)[14]	4696.4	4884.6	5521.7	5467.2	6214.8	6595.8	7003.3
CO_2 Emissions from Bunkers (Mt CO_2)	29.4	91.1	74.1	72.6	59.3	70.3	81.2

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	1.3	0.2	1.8	0.0	1.7	1.1	1.0
Coal	2.8	2.0	2.1	–2.9	2.2	0.4	0.6
Oil	1.2	–1.2	1.5	1.7	1.6	1.3	1.3
Gas	–1.3	–0.7	2.1	–2.4	2.0	2.4	2.1
Comb. Renewables & Wastes	5.9	1.5	1.9	7.0	1.4	1.4	0.9
Nuclear	20.3	7.7	1.2	7.2	0.0	–1.4	–4.0
Hydro	1.1	–0.3	2.7	–11.2	0.5	–0.0	–0.0
Geothermal	9.0	13.2	–1.0	3.1	1.1	2.2	2.5
Solar/Wind/Other	–	–	5.2	–9.9	13.8	6.1	2.2
TFC	0.8	–0.2	1.6	–0.6	2.1	1.3	1.2
Electricity Consumption	3.1	2.5	2.7	2.5	1.5	1.4	1.2
Energy Production	0.8	0.7	0.3	0.6	0.3	0.8	0.6
Net Oil Imports	5.1	–1.3	4.2	6.5	3.8	2.0	1.6
GDP	2.6	2.3	2.9	3.9	2.6	2.1	2.1
Growth in the TPES/GDP Ratio	–1.2	–2.1	–1.1	–3.7	–0.9	–1.0	–1.1
Growth in the TFC/GDP Ratio	–1.8	–2.4	–1.2	–4.3	–0.5	–0.8	–0.9

Please note: Rounding may cause totals to differ from the sum of the elements.

STANDARD REVIEWS

Energy Balances and Key Statistical Data

Australia

Belgium

Finland

Hungary

Ireland

Italy

Japan

New Zealand

Norway

Spain

Switzerland

Turkey

AUSTRALIA

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**68.0**	**157.2**	**200.9**	**212.0**	**248.6**	**280.4**	**298.5**
Coal[1]		40.3	106.3	140.7	147.9	169.6	185.4	196.5
Oil		19.8	28.5	27.9	30.8	30.4	29.4	29.3
Gas		3.4	17.1	25.5	26.6	41.4	58.0	64.9
Comb. Renewables & Wastes[2]		3.5	4.0	5.2	5.3	5.5	5.8	6.0
Nuclear		–	–	–	–	–	–	–
Hydro		1.0	1.2	1.4	1.4	1.5	1.5	1.5
Geothermal		–	..	..	..	–	–	–
Solar/Wind/Other[3]		–	0.1	0.1	0.1	0.1	0.2	0.2
TOTAL NET IMPORTS[4]		**–10.3**	**–65.5**	**–94.5**	**–108.4**	**–129.0**	**–152.6**	**–163.3**
Coal[1]	Exports	17.6	67.7	93.6	104.7	125.4	141.1	152.0
	Imports	–	–	–	–	–	–	–
	Net Imports	–17.6	–67.7	–93.6	–104.7	–125.4	–141.1	–152.0
Oil	Exports	3.4	9.2	16.0	18.1	22.2	24.4	27.7
	Imports	12.5	14.3	24.5	23.9	32.9	38.9	44.8
	Bunkers	1.8	0.6	0.8	0.7	0.9	0.9	0.9
	Net Imports	7.4	4.5	7.7	5.1	9.8	13.6	16.2
Gas	Exports	–	2.3	8.6	8.9	13.4	25.1	27.5
	Imports	–	–	–	–	–	–	–
	Net Imports	–	–2.3	–8.6	–8.9	–13.4	–25.1	–27.5
Electricity	Exports	–	–	–	–	–	–	–
	Imports	–	–	–	–	–	–	–
	Net Imports	–	–	–	–	–	–	–
TOTAL STOCK CHANGES		**–0.1**	**–4.5**	**–1.8**	**1.4**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**57.6**	**87.2**	**104.7**	**105.0**	**119.6**	**127.7**	**135.2**
Coal[1]		22.6	35.0	45.3	45.2	44.3	44.3	44.5
Oil		27.1	32.1	35.7	35.3	40.2	43.0	45.6
Gas		3.4	14.8	16.9	17.8	27.9	32.9	37.5
Comb. Renewables & Wastes[2]		3.5	4.0	5.2	5.3	5.5	5.8	6.0
Nuclear		–	–	–	–	–	–	–
Hydro		1.0	1.2	1.4	1.4	1.5	1.5	1.5
Geothermal		–	..	..	..	–	–	–
Solar/Wind/Other[3]		–	0.1	0.1	0.1	0.1	0.2	0.2
Electricity Trade[5]		–	–	–	–	–	–	–
Shares (%)								
Coal		*39.2*	*40.1*	*43.3*	*43.1*	*37.0*	*34.7*	*32.9*
Oil		*47.1*	*36.9*	*34.1*	*33.6*	*33.6*	*33.7*	*33.7*
Gas		*5.9*	*17.0*	*16.2*	*16.9*	*23.4*	*25.8*	*27.7*
Comb. Renewables & Wastes		*6.1*	*4.5*	*5.0*	*5.1*	*4.6*	*4.6*	*4.4*
Nuclear		–	–	–	–	–	–	–
Hydro		*1.7*	*1.4*	*1.4*	*1.3*	*1.3*	*1.2*	*1.1*
Geothermal		–	..	..	..	–	–	–
Solar/Wind/Other		–	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*
Electricity Trade		–	–	–	–	–	–	–

0 is negligible, – is nil, .. is not available.

Please note: All data except GDP and population refer to the fiscal year July to June.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**40.0**	**58.1**	**67.8**	**69.1**	**78.4**	**84.5**	**90.7**
Coal[1]	4.9	4.3	4.4	4.4	3.7	3.7	3.8
Oil	24.7	30.5	35.2	35.6	37.2	40.0	42.5
Gas	2.4	8.8	10.4	10.6	16.1	18.1	20.6
Comb. Renewables & Wastes[2]	3.5	3.3	4.4	4.5	5.0	5.2	5.1
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	0.1	0.1	0.1	0.1	0.2	0.2
Electricity	4.5	11.1	13.2	14.1	16.3	17.4	18.5
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*12.3*	*7.4*	*6.5*	*6.3*	*4.7*	*4.4*	*4.1*
Oil	*61.7*	*52.6*	*51.9*	*51.4*	*47.5*	*47.3*	*46.8*
Gas	*5.9*	*15.2*	*15.4*	*15.3*	*20.5*	*21.4*	*22.7*
Comb. Renewables & Wastes	*8.7*	*5.6*	*6.5*	*6.4*	*6.4*	*6.1*	*5.6*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.2*
Electricity	*11.3*	*19.1*	*19.5*	*20.3*	*20.7*	*20.6*	*20.4*
Heat	–	–	–	–	–	–	–
TOTAL INDUSTRY[6]	**17.6**	**23.1**	**26.3**	**27.0**	**31.8**	**34.1**	**36.4**
Coal[1]	4.6	4.1	4.3	4.2	3.5	3.6	3.6
Oil	7.7	6.3	7.0	7.1	5.8	6.1	6.4
Gas	1.8	6.1	6.8	6.9	11.8	13.1	14.8
Comb. Renewables & Wastes[2]	1.5	1.5	2.5	2.6	3.3	3.5	3.5
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	2.0	5.1	5.8	6.3	7.4	7.8	8.1
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*26.4*	*17.6*	*16.2*	*15.6*	*11.0*	*10.4*	*9.8*
Oil	*43.8*	*27.4*	*26.7*	*26.3*	*18.3*	*18.0*	*17.7*
Gas	*10.0*	*26.5*	*25.6*	*25.3*	*37.2*	*38.4*	*40.6*
Comb. Renewables & Wastes	*8.5*	*6.4*	*9.5*	*9.6*	*10.3*	*10.3*	*9.7*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*11.3*	*22.0*	*22.0*	*23.2*	*23.3*	*22.9*	*22.2*
Heat	–	–	–	–	–	–	–
TRANSPORT[7]	**13.5**	**22.7**	**26.7**	**27.0**	**29.8**	**32.3**	**34.7**
TOTAL OTHER SECTORS[8]	**8.9**	**12.3**	**14.7**	**15.1**	**16.9**	**18.1**	**19.6**
Coal[1]	0.3	0.1	0.1	0.1	0.1	0.1	0.1
Oil	3.5	1.8	2.0	2.0	2.2	2.3	2.5
Gas	0.6	2.7	3.4	3.5	4.1	4.6	5.1
Comb. Renewables & Wastes[2]	2.0	1.8	1.9	1.9	1.7	1.7	1.6
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	0.1	0.1	0.1	0.1	0.2	0.2
Electricity	2.5	5.9	7.3	7.6	8.6	9.3	10.2
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*3.2*	*1.1*	*0.5*	*0.5*	*0.4*	*0.4*	*0.3*
Oil	*39.7*	*14.2*	*13.3*	*13.1*	*13.0*	*12.9*	*12.6*
Gas	*7.0*	*21.8*	*23.4*	*23.3*	*24.4*	*25.2*	*26.1*
Comb. Renewables & Wastes	*22.5*	*14.4*	*12.9*	*12.4*	*10.3*	*9.1*	*8.0*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	*0.7*	*0.6*	*0.6*	*0.8*	*1.0*	*1.1*
Electricity	*27.7*	*47.7*	*49.4*	*50.2*	*51.0*	*51.3*	*51.8*
Heat	–	–	–	–	–	–	–

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**16.0**	**35.1**	**41.3**	**44.8**	**48.1**	**49.9**	**51.8**
OUTPUT (Mtoe)	**5.5**	**13.3**	**15.7**	**16.7**	**19.1**	**20.3**	**21.5**
(TWh gross)	64.4	154.3	182.7	194.3	221.6	236.1	250.5
Output Shares (%)							
Coal	*74.9*	*77.1*	*80.0*	*80.0*	*73.1*	*70.5*	*68.5*
Oil	*2.6*	*2.7*	*1.3*	*1.1*	*0.8*	*0.7*	*0.7*
Gas	*4.3*	*10.6*	*7.7*	*9.0*	*17.1*	*20.0*	*22.2*
Comb. Renewables & Wastes	*0.5*	*0.4*	*1.7*	*1.7*	*1.0*	*1.3*	*1.5*
Nuclear	–	–	–	–	–	–	–
Hydro	*17.7*	*9.2*	*9.2*	*8.1*	*7.9*	*7.5*	*7.2*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.0*	*0.0*	..	..	..
TOTAL LOSSES	**17.8**	**29.0**	**35.0**	**38.9**	**41.1**	**43.3**	**44.5**
of which:							
Electricity and Heat Generation[10]	10.5	21.7	25.6	28.0	29.5	29.6	30.7
Other Transformation	5.5	0.3	1.3	2.2	2.7	2.7	2.7
Own Use and Losses[11]	1.7	7.0	8.1	8.6	9.0	11.0	11.0
Statistical Differences	**–0.1**	**0.1**	**1.9**	**–3.0**	**–**	**–**	**–**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	179.64	295.61	364.10	382.67	493.49	577.66	669.67
Population (millions)	13.51	17.09	18.52	18.75	20.02	20.86	21.64
TPES/GDP[12]	0.32	0.29	0.29	0.27	0.24	0.22	0.20
Energy Production/TPES	1.18	1.80	1.92	2.02	2.08	2.20	2.21
Per Capita TPES[13]	4.27	5.10	5.65	5.60	5.97	6.12	6.25
Oil Supply/GDP[12]	0.15	0.11	0.10	0.09	0.08	0.07	0.07
TFC/GDP[12]	0.22	0.20	0.19	0.18	0.16	0.15	0.14
Per Capita TFC[13]	2.96	3.40	3.66	3.69	3.92	4.05	4.19
Energy-related CO_2 Emissions (Mt CO_2)[14]	175.6	263.0	317.9	317.8	351.3	370.7	389.0
CO_2 Emissions from Bunkers (Mt CO_2)	5.7	2.0	2.5	2.2	2.8	2.9	2.9

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	3.0	2.2	2.7	0.3	1.9	1.3	1.1
Coal	1.5	3.2	3.8	–0.2	–0.3	0.0	0.1
Oil	2.9	–0.0	1.5	–1.2	1.9	1.4	1.2
Gas	12.7	7.1	1.9	4.9	6.7	3.3	2.6
Comb. Renewables & Wastes	0.1	1.0	4.1	1.5	0.6	1.0	0.5
Nuclear	–	–	–	–	–	–	–
Hydro	5.1	–0.7	2.4	–5.8	1.5	0.2	0.2
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	17.3	1.5	1.1	6.0	5.5	4.3
TFC	2.5	2.1	2.2	2.0	1.8	1.5	1.4
Electricity Consumption	6.3	5.0	2.5	6.2	2.1	1.3	1.3
Energy Production	3.9	5.7	3.6	5.5	2.3	2.4	1.3
Net Oil Imports	4.2	–6.6	8.1	–33.9	9.7	6.8	3.6
GDP	2.8	3.1	3.0	5.1	3.7	3.2	3.0
Growth in the TPES/GDP Ratio	0.2	–0.9	–0.4	–4.5	–1.8	–1.8	–1.8
Growth in the TFC/GDP Ratio	–0.3	–1.0	–0.8	–2.9	–1.8	–1.7	–1.5

Please note: Rounding may cause totals to differ from the sum of the elements.

BELGIUM

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**6.5**	**12.8**	**13.1**	**12.8**	**12.5**	**12.9**	**..**
Coal[1]		6.4	1.2	0.2	0.2	–	–	..
Oil		..	–	–	–	–	–	..
Gas		0.0	0.0	–	–	–	–	..
Comb. Renewables & Wastes[2]		0.0	0.4	0.5	0.6	0.2	0.6	..
Nuclear		0.0	11.1	12.4	12.0	12.3	12.3	..
Hydro		0.0	0.0	0.0	0.0	0.0	0.0	..
Geothermal		–	0.0	0.0	0.0	..	..	..
Solar/Wind/Other[3]		–	0.0	0.0	0.0	0.0	0.0	..
TOTAL NET IMPORTS[4]		**39.8**	**35.5**	**43.8**	**46.3**	**41.9**	**44.4**	**..**
Coal[1]	Exports	0.8	1.1	1.3	1.0	0.9	0.9	..
	Imports	5.3	10.3	9.4	9.7	8.6	8.6	..
	Net Imports	4.6	9.2	8.2	8.6	7.7	7.7	..
Oil	Exports	15.1	19.2	20.8	21.4	16.0	16.4	..
	Imports	46.4	41.7	50.0	51.9	41.8	42.9	..
	Bunkers	3.1	4.1	5.1	5.4	4.0	4.0	..
	Net Imports	28.2	18.4	24.0	25.1	21.8	22.5	..
Gas	Exports	–	–	–	–	–	–	..
	Imports	7.1	8.2	11.3	12.4	12.4	14.2	..
	Net Imports	7.1	8.2	11.3	12.4	12.4	14.2	..
Electricity	Exports	0.2	0.7	0.6	0.6	..	..	..
	Imports	0.1	0.4	0.9	0.7	..	..	..
	Net Imports	–0.1	–0.3	0.3	0.1	..	..	..
TOTAL STOCK CHANGES		**–0.0**	**0.1**	**0.2**	**–0.8**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**46.3**	**48.4**	**57.1**	**58.3**	**54.4**	**57.3**	**..**
Coal[1]		11.2	10.2	8.5	8.6	7.7	7.7	..
Oil		28.0	18.7	24.2	24.6	21.8	22.5	..
Gas		7.1	8.2	11.3	12.5	12.4	14.2	..
Comb. Renewables & Wastes[2]		0.0	0.4	0.5	0.6	0.2	0.6	..
Nuclear		0.0	11.1	12.4	12.0	12.3	12.3	..
Hydro		0.0	0.0	0.0	0.0	0.0	0.0	..
Geothermal		–	0.0	0.0	0.0	..	..	..
Solar/Wind/Other[3]		–	0.0	0.0	0.0	0.0	0.0	..
Electricity Trade[5]		–0.1	–0.3	0.3	0.1	–	–	..
Shares (%)								
Coal		*24.1*	*21.1*	*14.9*	*14.7*	*14.2*	*13.4*	..
Oil		*60.5*	*38.7*	*42.3*	*42.1*	*40.1*	*39.3*	..
Gas		*15.4*	*16.9*	*19.7*	*21.4*	*22.8*	*24.7*	..
Comb. Renewables & Wastes		–	*0.9*	*0.9*	*1.0*	*0.3*	*1.0*	..
Nuclear		–	*23.0*	*21.6*	*20.6*	*22.6*	*21.4*	..
Hydro		–	–	–	*0.1*	*0.1*	*0.1*	..
Geothermal		–	–	–	–	..	..	..
Solar/Wind/Other		–	–	–	–	–	–	..
Electricity Trade		*–0.1*	*–0.7*	*0.5*	*0.2*	–	–	..

0 is negligible, – is nil, .. is not available.

Please note: All forecast data are based on the 1996 submission.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**34.6**	**32.9**	**40.4**	**41.1**	**39.5**	**41.0**	**..**
Coal[1]	5.7	3.4	2.7	2.6	3.7	3.7	..
Oil	21.0	17.3	22.1	22.3	20.1	20.8	..
Gas	4.6	6.8	9.0	9.3	8.8	9.0	..
Comb. Renewables & Wastes[2]	–	0.2	0.2	0.2	..	..	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	2.9	5.0	6.2	6.4	6.0	6.4	..
Heat	0.3	0.2	0.3	0.3	0.9	1.1	..
Shares (%)							
Coal	*16.5*	*10.2*	*6.6*	*6.4*	*9.4*	*9.0*	..
Oil	*60.7*	*52.6*	*54.8*	*54.2*	*50.8*	*50.7*	..
Gas	*13.3*	*20.7*	*22.2*	*22.7*	*22.3*	*22.0*	..
Comb. Renewables & Wastes	–	*0.6*	*0.4*	*0.4*	..	..	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*8.5*	*15.1*	*15.3*	*15.5*	*15.1*	*15.7*	..
Heat	*0.9*	*0.7*	*0.7*	*0.8*	*2.3*	*2.6*	..
TOTAL INDUSTRY[6]	**16.8**	**13.4**	**16.2**	**16.5**	**15.7**	**16.1**	**..**
Coal[1]	3.5	2.9	2.4	2.4	3.4	3.4	..
Oil	7.9	4.3	6.1	6.1	4.1	4.1	..
Gas	3.2	3.3	4.3	4.4	3.9	3.9	..
Comb. Renewables & Wastes[2]	–	0.0	0.0	0.0	..	..	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	1.9	2.6	3.1	3.2	3.4	3.7	..
Heat	0.3	0.2	0.2	0.3	0.8	0.9	..
Shares (%)							
Coal	*21.1*	*21.7*	*14.5*	*14.6*	*21.8*	*21.3*	..
Oil	*46.8*	*32.4*	*37.9*	*37.2*	*26.4*	*25.6*	..
Gas	*18.7*	*24.7*	*26.6*	*27.0*	*25.1*	*24.5*	..
Comb. Renewables & Wastes	–	*0.1*	*0.1*	*0.1*	..	..	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*11.5*	*19.7*	*19.4*	*19.5*	*21.8*	*23.0*	..
Heat	*1.9*	*1.4*	*1.5*	*1.7*	*4.8*	*5.5*	..
TRANSPORT[7]	**5.0**	**7.9**	**9.4**	**9.8**	**9.4**	**9.7**	**..**
TOTAL OTHER SECTORS[8]	**12.7**	**11.7**	**14.8**	**14.8**	**14.4**	**15.2**	**..**
Coal[1]	2.2	0.5	0.3	0.2	0.3	0.3	..
Oil	8.1	5.2	6.7	6.4	6.6	7.2	..
Gas	1.5	3.5	4.7	4.9	4.9	5.1	..
Comb. Renewables & Wastes[2]	–	0.2	0.2	0.2	..	..	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	0.9	2.3	2.9	3.0	2.4	2.6	..
Heat	–	0.0	0.0	0.0	0.2	0.2	..
Shares (%)							
Coal	*17.0*	*4.1*	*2.1*	*1.5*	*2.1*	*1.6*	..
Oil	*64.2*	*44.6*	*45.2*	*43.5*	*46.1*	*47.0*	..
Gas	*11.4*	*30.1*	*31.5*	*33.1*	*34.0*	*33.2*	..
Comb. Renewables & Wastes	–	*1.6*	*1.1*	*1.2*	..	..	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*7.4*	*19.3*	*19.8*	*20.5*	*16.7*	*16.9*	..
Heat	–	*0.3*	*0.2*	*0.3*	*1.2*	*1.2*	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**10.0**	**17.5**	**19.1**	**19.6**	**20.0**	**22.0**	**..**
OUTPUT (Mtoe)	**3.5**	**6.0**	**6.7**	**7.1**	**6.7**	**7.3**	**..**
(TWh gross)	40.6	70.2	77.9	82.1	78.3	84.9	..
Output Shares (%)							
Coal	*21.7*	*28.3*	*20.9*	*20.6*	*11.5*	*8.7*	..
Oil	*53.7*	*1.9*	*1.8*	*3.1*	*2.3*	*2.3*	..
Gas	*23.7*	*7.7*	*14.8*	*18.3*	*24.7*	*29.6*	..
Comb. Renewables & Wastes	*0.3*	*0.9*	*1.2*	*1.3*	*1.0*	*3.5*	..
Nuclear	*0.2*	*60.8*	*60.8*	*56.2*	*60.1*	*55.5*	..
Hydro	*0.4*	*0.4*	*0.4*	*0.5*	*0.4*	*0.4*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	..
TOTAL LOSSES	**11.8**	**16.0**	**16.5**	**16.6**	**14.9**	**16.3**	**..**
of which:							
Electricity and Heat Generation[10]	6.2	11.3	12.1	12.2	12.3	13.6	..
Other Transformation	4.2	2.1	1.6	1.6	1.3	1.3	..
Own Use and Losses[11]	1.4	2.7	2.8	2.7	1.3	1.5	..
Statistical Differences	**–0.1**	**–0.5**	**0.3**	**0.7**	**–**	**–**	**..**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	135.59	196.13	218.25	224.57	263.32	295.02	..
Population (millions)	9.74	9.97	10.18	10.20	10.00	10.00	–
TPES/GDP[12]	0.34	0.25	0.26	0.26	0.21	0.19	..
Energy Production/TPES	0.14	0.26	0.23	0.22	0.23	0.23	..
Per Capita TPES[13]	4.76	4.86	5.61	5.72	5.44	5.73	..
Oil Supply/GDP[12]	0.21	0.10	0.11	0.11	0.08	0.08	..
TFC/GDP[12]	0.25	0.17	0.19	0.18	0.15	0.14	..
Per Capita TFC[13]	3.55	3.30	3.97	4.03	3.95	4.10	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	138.5	109.1	122.6	127.1	113.8	119.8	..
CO_2 Emissions from Bunkers (Mt CO_2)	9.7	13.1	16.2	17.3	12.6	12.6	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	0.7	0.0	2.4	2.2	–1.0	1.0	–
Coal	–1.0	–0.3	–2.6	1.0	–1.5	–	–
Oil	–1.5	–2.8	3.7	1.7	–1.7	0.6	–
Gas	4.5	–1.2	4.7	10.7	–0.1	2.7	–
Comb. Renewables & Wastes	41.7	17.8	2.5	5.9	–17.1	31.5	–
Nuclear	130.2	12.8	1.5	–2.6	0.3	–	–
Hydro	4.9	1.3	1.8	26.9	–1.4	–	–
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–9.4	–	–
TFC	0.3	–0.6	3.0	1.7	–0.6	0.7	–
Electricity Consumption	4.2	2.6	3.1	3.0	–0.9	1.5	–
Energy Production	2.4	5.0	0.4	–2.4	–0.4	0.7	–
Net Oil Imports	–0.8	–3.4	3.9	4.5	–2.0	0.6	–
GDP	2.4	2.1	1.5	2.9	2.3	2.3	–
Growth in the TPES/GDP Ratio	–1.6	–2.1	0.8	–0.7	–3.2	–1.2	–
Growth in the TFC/GDP Ratio	–2.0	–2.7	1.4	–1.1	–2.8	–1.5	–

Please note: Rounding may cause totals to differ from the sum of the elements.

FINLAND

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**4.9**	**11.7**	**15.1**	**13.6**	**14.2**	**14.3**	**..**
Coal[1]		–	–	–	–	–	–	..
Peat		0.1	1.8	2.6	0.4	2.2	2.2	..
Oil		–	–	0.1	0.1	–	–	..
Gas		–	–	–	–	–	–	..
Comb. Renewables & Wastes[2]		3.9	4.0	5.9	6.1	5.7	5.8	..
Nuclear		–	5.0	5.4	5.7	5.2	5.2	..
Hydro		0.9	0.9	1.1	1.3	1.1	1.1	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	–	0.0	0.0	0.0	0.0	..
TOTAL NET IMPORTS[4]		**16.6**	**17.7**	**18.5**	**17.8**	**20.5**	**20.9**	**..**
Coal[1]	Exports	0.0	0.0	–	–	0.0	0.0	..
	Imports	2.4	4.4	4.8	3.3	5.3	5.3	..
	Net Imports	2.4	4.4	4.8	3.3	5.3	5.3	..
Peat	Exports	–	–	0.0	0.0	–	–	..
	Imports	–	–	–	–	–	–	..
	Net Imports	–	–	–0.0	–0.0	–	–	..
Oil	Exports	0.2	1.7	4.3	4.9	4.5	4.5	..
	Imports	14.0	12.5	14.9	15.8	14.2	14.2	..
	Bunkers	0.1	0.6	0.4	0.5	0.4	0.4	..
	Net Imports	13.8	10.2	10.1	10.4	9.3	9.3	..
Gas	Exports	–	–	–	–	–	–	..
	Imports	–	2.2	2.9	3.3	5.2	5.6	..
	Net Imports	–	2.2	2.9	3.3	5.2	5.6	..
Electricity	Exports	0.0	0.0	0.0	0.0	–	–	..
	Imports	0.4	0.9	0.7	0.8	0.7	0.7	..
	Net Imports	0.4	0.9	0.7	0.8	0.7	0.7	..
TOTAL STOCK CHANGES		**–0.1**	**–0.6**	**–0.5**	**2.1**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**21.3**	**28.8**	**33.1**	**33.5**	**34.7**	**35.2**	**..**
Coal[1]		2.5	4.1	4.8	3.6	5.3	5.3	..
Peat		0.0	1.2	2.1	1.9	2.2	2.2	..
Oil		13.6	10.3	10.3	10.7	9.3	9.3	..
Gas		–	2.2	2.9	3.3	5.2	5.6	..
Comb. Renewables & Wastes[2]		3.9	4.2	5.9	6.1	5.7	5.8	..
Nuclear		–	5.0	5.4	5.7	5.2	5.2	..
Hydro		0.9	0.9	1.1	1.3	1.1	1.1	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	–	0.0	0.0	0.0	0.0	..
Electricity Trade[5]		0.4	0.9	0.7	0.8	0.7	0.7	..
Shares (%)								
Coal		*11.8*	*14.2*	*14.5*	*10.7*	*15.3*	*15.1*	..
Peat		*0.2*	*4.2*	*6.2*	*5.6*	*6.3*	*6.3*	..
Oil		*63.6*	*35.6*	*31.1*	*32.1*	*26.8*	*26.4*	..
Gas		–	*7.6*	*8.8*	*10.0*	*15.0*	*15.9*	..
Comb. Renewables & Wastes		*18.5*	*14.6*	*17.7*	*18.3*	*16.4*	*16.5*	..
Nuclear		–	*17.4*	*16.5*	*17.0*	*15.0*	*14.8*	..
Hydro		*4.2*	*3.2*	*3.2*	*3.9*	*3.2*	*3.1*	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other		–	–	–	–	–	–	..
Electricity Trade		*1.7*	*3.2*	*2.0*	*2.4*	*2.0*	*2.0*	..

0 is negligible, – is nil, .. is not available.

Please note: All forecast data are based on the 1997 submission. Forecast data for electricity and heat generation are IEA Secretariat estimates.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**19.4**	**22.6**	**24.2**	**25.0**	**25.5**	**26.3**	**..**
Coal[1]	1.0	1.2	0.8	0.8	0.8	0.8	..
Peat	0.0	0.4	0.3	0.5	0.4	0.4	..
Oil	11.5	9.7	8.5	8.7	7.4	7.4	..
Gas	0.0	1.2	1.4	1.5	2.6	2.7	..
Comb. Renewables & Wastes[2]	3.9	3.2	4.4	4.6	4.2	4.3	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	2.3	5.1	6.1	6.3	7.6	8.0	..
Heat	0.6	1.9	2.7	2.5	2.5	2.6	..
Shares (%)							
Coal	*5.3*	*5.2*	*3.4*	*3.4*	*3.1*	*3.0*	..
Peat	*0.1*	*1.8*	*1.3*	*2.0*	*1.6*	*1.5*	..
Oil	*59.2*	*42.8*	*35.1*	*34.8*	*29.1*	*28.3*	..
Gas	*0.1*	*5.4*	*5.7*	*6.1*	*10.2*	*10.3*	..
Comb. Renewables & Wastes	*20.3*	*14.0*	*18.3*	*18.5*	*16.3*	*16.2*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*11.9*	*22.5*	*25.0*	*25.0*	*29.7*	*30.6*	..
Heat	*3.1*	*8.5*	*11.2*	*10.1*	*9.9*	*10.1*	..
TOTAL INDUSTRY[6]	**7.6**	**10.7**	**11.6**	**12.1**	**12.7**	**13.3**	**..**
Coal[1]	0.9	1.2	0.8	0.8	0.8	0.8	..
Peat	0.0	0.4	0.3	0.5	0.4	0.4	..
Oil	5.0	2.6	1.9	2.0	1.9	1.9	..
Gas	0.0	1.2	1.3	1.5	2.2	2.3	..
Comb. Renewables & Wastes[2]	–	2.5	3.3	3.5	3.1	3.2	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	1.6	2.8	3.4	3.5	4.2	4.6	..
Heat	0.1	0.2	0.6	0.4	0.2	0.2	..
Shares (%)							
Coal	*12.1*	*10.8*	*7.1*	*7.0*	*6.2*	*5.9*	..
Peat	*0.2*	*3.6*	*2.5*	*3.8*	*3.0*	*2.9*	..
Oil	*66.2*	*24.2*	*16.4*	*16.5*	*15.1*	*14.4*	..
Gas	*0.1*	*10.9*	*11.1*	*12.0*	*16.9*	*16.9*	..
Comb. Renewables & Wastes	–	*22.9*	*28.4*	*28.8*	*24.0*	*23.6*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*20.4*	*26.1*	*29.2*	*28.9*	*33.0*	*34.5*	..
Heat	*1.0*	*1.6*	*5.4*	*2.9*	*1.8*	*1.8*	..
TRANSPORT[7]	**2.6**	**4.4**	**4.4**	**4.4**	**4.2**	**4.2**	**..**
TOTAL OTHER SECTORS[8]	**9.3**	**7.5**	**8.2**	**8.5**	**8.5**	**8.7**	**..**
Coal[1]	0.1	0.0	0.0	0.0	0.0	0.0	..
Peat	0.0	0.0	0.0	0.0	0.0	0.0	..
Oil	3.9	2.7	2.3	2.4	1.4	1.4	..
Gas	0.0	0.0	0.1	0.1	0.4	0.4	..
Comb. Renewables & Wastes[2]	3.9	0.7	1.1	1.1	1.1	1.1	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	0.8	2.2	2.6	2.7	3.3	3.4	..
Heat	0.5	1.7	2.1	2.2	2.3	2.4	..
Shares (%)							
Coal	*1.1*	*0.1*	–	–	*0.1*	*0.1*	..
Peat	*0.1*	*0.2*	*0.4*	*0.3*	*0.2*	*0.2*	..
Oil	*42.3*	*36.7*	*28.0*	*27.9*	*16.4*	*16.1*	..
Gas	–	*0.6*	*0.8*	*0.7*	*4.8*	*4.7*	..
Comb. Renewables & Wastes	*42.6*	*9.3*	*13.7*	*13.4*	*12.9*	*12.6*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*8.2*	*29.9*	*31.8*	*32.0*	*38.7*	*38.8*	..
Heat	*5.7*	*23.2*	*25.3*	*25.7*	*26.9*	*27.6*	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**3.5**	**11.9**	**15.2**	**14.4**	**16.4**	**16.7**	**..**
OUTPUT (Mtoe)	**2.2**	**4.7**	**5.9**	**6.0**	**7.2**	**7.7**	**..**
(TWh gross)	26.1	54.4	69.2	70.2	83.4	89.2	..
Output Shares (%)							
Coal	*18.7*	*18.5*	*19.0*	*12.2*	*29.1*	*32.2*	..
Peat	*9.4*	*14.6*	*9.3*	*7.0*	*8.0*	*7.5*	..
Oil	*31.6*	*3.1*	*2.0*	*1.6*	*1.6*	*1.5*	..
Gas	–	*8.6*	*10.0*	*12.6*	*12.8*	*13.5*	..
Comb. Renewables & Wastes	–	–	*11.8*	*13.9*	*9.2*	*8.6*	..
Nuclear	–	*35.3*	*30.2*	*31.1*	*23.9*	*22.4*	..
Hydro	*40.3*	*20.0*	*17.7*	*21.4*	*15.3*	*14.3*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	*0.0*	*0.0*	*0.0*	*0.1*	..
TOTAL LOSSES	**2.0**	**6.9**	**8.3**	**7.8**	**9.2**	**8.9**	**..**
of which:							
Electricity and Heat Generation[10]	0.6	5.1	6.3	5.6	6.5	6.2	..
Other Transformation	0.5	0.6	0.6	0.8	2.2	2.2	..
Own Use and Losses[11]	0.9	1.2	1.4	1.4	0.5	0.5	..
Statistical Differences	**–0.1**	**–0.7**	**0.6**	**0.6**	**–**	**–**	**..**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	82.91	134.81	143.99	150.75	185.40	210.79	..
Population (millions)	4.67	4.99	5.14	5.15	5.21	5.23	..
TPES/GDP[12]	0.26	0.21	0.23	0.22	0.19	0.17	..
Energy Production/TPES	0.23	0.41	0.46	0.41	0.41	0.41	..
Per Capita TPES[13]	4.57	5.78	6.43	6.49	6.66	6.73	..
Oil Supply/GDP[12]	0.16	0.08	0.07	0.07	0.05	0.04	..
TFC/GDP[12]	0.23	0.17	0.17	0.17	0.14	0.12	..
Per Capita TFC[13]	4.16	4.53	4.71	4.85	4.89	5.02	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	49.3	54.4	64.1	60.7	68.8	69.8	..
CO_2 Emissions from Bunkers (Mt CO2)	0.3	1.8	1.3	1.6	1.3	1.3	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	2.3	1.5	2.0	1.2	0.5	0.3	..
Coal	7.4	0.6	2.3	–25.2	5.7	–	..
Peat	48.1	10.6	7.7	–8.1	2.2	–	..
Oil	–0.5	–2.3	0.1	4.3	–2.0	–	..
Gas	–	9.4	4.2	14.8	6.6	1.5	..
Comb. Renewables & Wastes	–2.4	1.9	4.9	4.3	–1.0	0.3	..
Nuclear	–	10.0	1.2	4.6	–1.3	–	..
Hydro	0.6	–0.0	1.7	22.9	–2.3	–	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	100.0	6.0	10.8	..
TFC	0.4	1.2	1.0	3.4	0.3	0.6	..
Electricity Consumption	4.7	4.7	2.6	3.5	2.7	1.2	..
Energy Production	4.7	5.6	3.6	–9.6	0.6	0.1	..
Net Oil Imports	1.1	–3.3	–0.1	2.6	–1.6	–	..
GDP	2.1	3.3	0.9	4.7	3.0	2.6	..
Growth in the TPES/GDP Ratio	0.1	–1.7	1.0	–3.4	–2.4	–2.3	..
Growth in the TFC/GDP Ratio	–1.7	–2.1	0.1	–1.3	–2.7	–1.9	..

Please note: Rounding may cause totals to differ from the sum of the elements.

HUNGARY

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**12.84**	**14.23**	**12.66**	**11.85**	**11.15**	**10.30**	**9.56**
Coal[1]		6.05	4.14	3.30	3.05	1.90	2.20	2.10
Oil		2.02	2.29	1.99	1.87	1.47	1.07	0.90
Gas		4.03	3.81	3.36	2.97	2.71	1.91	1.50
Comb. Renewables & Wastes[2]		0.73	0.40	0.35	0.32	0.39	0.40	0.34
Nuclear		–	3.58	3.64	3.64	3.75	3.75	3.75
Hydro		0.01	0.02	0.02	0.01	0.02	0.02	0.02
Geothermal		–	–	–	–	0.91	0.96	0.96
Solar/Wind/Other[3]		–	–	–	–	–	–	–
TOTAL NET IMPORTS[4]		**8.66**	**14.17**	**13.40**	**14.15**	**16.24**	**17.51**	**18.86**
Coal[1]	Exports	0.11	–	0.20	0.13	0.13	–	–
	Imports	1.74	1.63	1.57	1.25	1.28	0.67	0.77
	Net Imports	1.63	1.63	1.37	1.12	1.14	0.67	0.77
Oil	Exports	0.92	1.52	1.95	1.85	1.80	1.80	1.80
	Imports	7.39	7.96	7.25	7.74	7.67	8.32	8.78
	Bunkers	–	–	–	–	–	–	–
	Net Imports	6.48	6.44	5.30	5.89	5.87	6.52	6.98
Gas	Exports	0.01	0.02	–	0.00	–	–	–
	Imports	0.17	5.19	6.55	7.08	9.06	10.17	10.96
	Net Imports	0.15	5.17	6.55	7.08	9.06	10.17	10.96
Electricity	Exports	0.09	0.19	0.19	0.28	0.16	0.16	0.16
	Imports	0.49	1.14	0.38	0.35	0.32	0.31	0.31
	Net Imports	0.40	0.96	0.19	0.06	0.16	0.16	0.16
TOTAL STOCK CHANGES		**–0.02**	**0.06**	**–0.63**	**–0.74**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**21.47**	**28.46**	**25.44**	**25.26**	**27.38**	**27.81**	**28.42**
Coal[1]		7.91	6.12	4.56	4.17	3.04	2.87	2.87
Oil		8.21	8.52	6.97	7.28	7.34	7.59	7.88
Gas		4.17	8.91	9.71	9.77	11.77	12.08	12.46
Comb. Renewables & Wastes[2]		0.78	0.35	0.36	0.33	0.39	0.40	0.34
Nuclear		–	3.58	3.64	3.64	3.75	3.75	3.75
Hydro		0.01	0.02	0.02	0.01	0.02	0.02	0.02
Geothermal		–	–	–	–	0.91	0.96	0.96
Solar/Wind/Other[3]		–	–	–	–	–	–	–
Electricity Trade[5]		0.40	0.96	0.19	0.06	0.16	0.16	0.16
Shares (%)								
Coal		*36.8*	*21.5*	*17.9*	*16.5*	*11.1*	*10.3*	*10.1*
Oil		*38.2*	*29.9*	*27.4*	*28.8*	*26.8*	*27.3*	*27.7*
Gas		*19.4*	*31.3*	*38.2*	*38.7*	*43.0*	*43.4*	*43.8*
Comb. Renewables & Wastes		*3.6*	*1.2*	*1.4*	*1.3*	*1.4*	*1.4*	*1.2*
Nuclear		–	*12.6*	*14.3*	*14.4*	*13.7*	*13.5*	*13.2*
Hydro		–	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Geothermal		–	–	–	–	*3.3*	*3.4*	*3.4*
Solar/Wind/Other		–	–	–	–	–	–	–
Electricity Trade		*1.9*	*3.4*	*0.7*	*0.3*	*0.6*	*0.6*	*0.5*

0 is negligible,– is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**17.28**	**20.93**	**17.00**	**17.23**	**18.57**	**18.95**	**19.42**
Coal[1]	4.17	2.68	0.84	0.68	0.78	0.78	0.78
Oil	6.71	7.41	5.16	5.51	5.85	6.03	6.40
Gas	3.08	6.20	6.73	6.69	7.15	7.26	7.30
Comb. Renewables & Wastes[2]	0.76	0.34	0.35	0.32	0.55	0.51	0.45
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	1.51	2.72	2.48	2.51	2.68	2.78	2.89
Heat	1.06	1.59	1.44	1.51	1.56	1.60	1.60
Shares (%)							
Coal	*24.1*	*12.8*	*5.0*	*4.0*	*4.2*	*4.1*	*4.0*
Oil	*38.8*	*35.4*	*30.3*	*32.0*	*31.5*	*31.8*	*33.0*
Gas	*17.8*	*29.6*	*39.6*	*38.8*	*38.5*	*38.3*	*37.6*
Comb. Renewables & Wastes	*4.4*	*1.6*	*2.1*	*1.9*	*2.9*	*2.7*	*2.3*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*8.7*	*13.0*	*14.6*	*14.6*	*14.5*	*14.7*	*14.9*
Heat	*6.1*	*7.6*	*8.5*	*8.8*	*8.4*	*8.4*	*8.2*
TOTAL INDUSTRY[6]	**7.90**	**8.06**	**5.09**	**5.34**	**5.34**	**5.44**	**5.46**
Coal[1]	1.87	0.80	0.45	0.43	0.50	0.50	0.50
Oil	2.34	2.11	1.54	1.68	1.65	1.70	1.80
Gas	2.29	3.76	1.95	2.05	1.90	1.90	1.90
Comb. Renewables & Wastes[2]	0.02	0.00	0.00	–	0.11	0.11	–
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.92	1.18	0.76	0.74	0.78	0.82	0.85
Heat	0.46	0.21	0.40	0.45	0.40	0.41	0.41
Shares (%)							
Coal	*23.6*	*9.9*	*8.8*	*8.1*	*9.4*	*9.2*	*9.2*
Oil	*29.6*	*26.2*	*30.2*	*31.4*	*30.9*	*31.3*	*33.0*
Gas	*29.0*	*46.6*	*38.3*	*38.3*	*35.6*	*35.0*	*34.8*
Comb. Renewables & Wastes	*0.2*	–	*0.1*	–	*2.0*	*1.9*	–
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*11.7*	*14.7*	*14.9*	*13.8*	*14.7*	*15.1*	*15.6*
Heat	*5.9*	*2.6*	*7.8*	*8.4*	*7.5*	*7.5*	*7.5*
TRANSPORT[7]	**2.37**	**3.15**	**2.85**	**3.14**	**3.48**	**3.58**	**3.68**
TOTAL OTHER SECTORS[8]	**7.02**	**9.72**	**9.07**	**8.76**	**9.74**	**9.94**	**10.27**
Coal[1]	1.93	1.88	0.40	0.25	0.28	0.28	0.28
Oil	2.45	2.25	0.87	0.79	0.80	0.83	1.00
Gas	0.78	2.44	4.78	4.64	5.25	5.36	5.40
Comb. Renewables & Wastes[2]	0.74	0.34	0.35	0.32	0.44	0.40	0.45
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.52	1.43	1.63	1.70	1.82	1.88	1.95
Heat	0.60	1.38	1.04	1.06	1.16	1.19	1.19
Shares (%)							
Coal	*27.5*	*19.4*	*4.4*	*2.9*	*2.9*	*2.8*	*2.7*
Oil	*34.9*	*23.1*	*9.6*	*9.0*	*8.2*	*8.4*	*9.7*
Gas	*11.2*	*25.1*	*52.7*	*53.0*	*53.9*	*53.9*	*52.6*
Comb. Renewables & Wastes	*10.5*	*3.5*	*3.8*	*3.7*	*4.5*	*4.0*	*4.4*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*7.4*	*14.7*	*18.0*	*19.4*	*18.6*	*18.9*	*19.0*
Heat	*8.5*	*14.2*	*11.5*	*12.1*	*11.9*	*11.9*	*11.5*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**6.37**	**10.21**	**10.65**	**10.85**	**11.77**	**12.36**	**12.72**
OUTPUT (Mtoe)	**1.52**	**2.45**	**3.04**	**3.20**	**3.32**	**3.45**	**3.59**
(TWh gross)	17.64	28.44	35.40	37.19	38.60	40.17	41.80
Output Shares (%)							
Coal	*66.0*	*30.5*	*26.9*	*26.0*	*18.1*	*19.9*	*19.1*
Oil	*17.2*	*4.8*	*16.6*	*16.0*	*9.1*	*9.5*	*9.3*
Gas	*16.2*	*15.8*	*16.5*	*20.0*	*34.3*	*33.7*	*36.0*
Comb. Renewables & Wastes	–	–	–	–	*0.6*	*0.6*	*0.6*
Nuclear	–	*48.3*	*39.5*	*37.5*	*37.3*	*35.8*	*34.4*
Hydro	*0.6*	*0.6*	*0.6*	*0.4*	*0.5*	*0.5*	*0.5*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
TOTAL LOSSES	**4.48**	**7.98**	**8.18**	**7.95**	**8.82**	**8.85**	**9.01**
of which:							
Electricity and Heat Generation[10]	3.67	6.00	5.98	5.98	6.74	7.14	7.36
Other Transformation	–0.17	–0.04	0.17	0.05	0.16	–0.24	–0.24
Own Use and Losses[11]	0.99	2.02	2.03	1.93	1.93	1.95	1.89
Statistical Differences	**–0.29**	**–0.45**	**0.26**	**0.07**	**–**	**–**	**–**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	24.18	35.78	33.64	35.34	43.46	50.38	58.41
Population (millions)	10.43	10.37	10.16	10.11	9.82	9.62	9.40
TPES/GDP[12]	0.89	0.80	0.76	0.71	0.63	0.55	0.49
Energy Production/TPES	0.60	0.50	0.50	0.47	0.41	0.37	0.34
Per Capita TPES[13]	2.06	2.75	2.50	2.50	2.79	2.89	3.02
Oil Supply/GDP[12]	0.34	0.24	0.21	0.21	0.17	0.15	0.13
TFC/GDP[12]	0.71	0.59	0.51	0.49	0.43	0.38	0.33
Per Capita TFC[13]	1.66	2.02	1.67	1.70	1.89	1.97	2.07
Energy-related CO_2 Emissions (Mt CO_2)[14]	64.2	68.1	59.0	58.0	58.3	59.3	60.9
CO_2 Emissions from Bunkers (Mt CO_2)	–	–	–	–	–	–	–

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	4.9	–0.1	–1.6	–0.7	1.2	0.3	0.4
Coal	1.2	–3.0	–4.1	–8.6	–4.4	–1.2	–
Oil	5.7	–2.6	–2.8	4.3	0.1	0.7	0.8
Gas	10.0	1.7	1.2	0.7	2.7	0.5	0.6
Comb. Renewables & Wastes	0.9	–7.4	0.1	–8.4	2.5	0.3	–3.1
Nuclear	–	–	0.2	–0.1	0.4	–	–
Hydro	6.3	1.3	3.4	–31.6	3.9	–	–
Geothermal	–	–	–	–	–	1.0	–
Solar/Wind/Other	–	–	–	–	–	–	–
TFC	4.6	–0.7	–2.9	1.4	1.1	0.4	0.5
Electricity Consumption	6.0	2.2	–1.3	1.3	0.9	0.7	0.7
Energy Production	2.6	–0.4	–1.7	–6.4	–0.9	–1.6	–1.5
Net Oil Imports	7.1	–3.8	–2.7	11.1	–0.0	2.1	1.4
GDP	4.3	1.3	–0.9	5.1	3.0	3.0	3.0
Growth in the TPES/GDP Ratio	0.6	–1.3	–0.7	–5.5	–1.8	–2.6	–2.5
Growth in the TFC/GDP Ratio	0.3	–2.0	–2.1	–3.5	–1.9	–2.5	–2.4

Please note: Rounding may cause totals to differ from the sum of the elements.

IRELAND

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**1.120**	**3.359**	**2.871**	**2.465**	**3.282**	**2.810**	**2.814**
Coal[1]		0.045	0.016	–	–	–	–	–
Peat		1.020	1.411	0.740	0.813	0.778	0.592	0.534
Oil		..	–	–	–	–	–	–
Gas		–	1.872	1.906	1.406	2.068	1.697	1.697
Comb. Renewables & Wastes[2]		–	–	0.162	0.152	0.261	0.304	0.326
Nuclear		–	–	–	–	–	–	–
Hydro		0.055	0.060	0.058	0.079	0.071	0.073	0.074
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	–	0.004	0.015	0.104	0.144	0.183
TOTAL NET IMPORTS[4]		**5.901**	**7.353**	**9.599**	**10.699**	**12.152**	**14.459**	**15.889**
Coal[1]	Exports	0.073	0.023	0.013	0.017	0.015	0.010	0.005
	Imports	0.578	2.286	2.100	1.925	1.879	1.750	1.673
	Net Imports	0.505	2.263	2.087	1.908	1.864	1.740	1.668
Peat	Exports	–	–	–	–	–	–	–
	Imports	–	–	–	–	–	–	–
	Net Imports	–	–	–	–	–	–	–
Oil	Exports	0.472	0.680	1.334	1.259	1.341	1.341	1.341
	Imports	5.956	5.788	8.135	8.808	9.318	10.449	11.068
	Bunkers	0.092	0.018	0.153	0.160	0.042	0.052	0.042
	Net Imports	5.392	5.090	6.648	7.389	7.935	9.056	9.685
Gas	Exports	–	–	–	–	–	–	–
	Imports	–	–	0.865	1.395	2.353	3.663	4.536
	Net Imports	–	–	0.865	1.395	2.353	3.663	4.536
Electricity	Exports	0.002	–	0.007	0.006	–	–	–
	Imports	0.006	–	0.006	0.013	–	–	–
	Net Imports	0.004	–	–0.001	0.007	–	–	–
TOTAL STOCK CHANGES		**0.168**	**–0.250**	**0.059**	**0.086**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**7.189**	**10.463**	**12.529**	**13.251**	**15.434**	**17.269**	**18.703**
Coal[1]		0.565	2.371	1.940	1.938	1.864	1.740	1.668
Peat		1.020	1.288	1.052	0.993	0.778	0.592	0.534
Oil		5.545	4.871	6.541	7.266	7.935	9.056	9.685
Gas		–	1.872	2.771	2.802	4.421	5.360	6.233
Comb. Renewables & Wastes[2]		–	–	0.162	0.152	0.261	0.304	0.326
Nuclear		–	–	–	–	–	–	–
Hydro		0.055	0.060	0.058	0.079	0.071	0.073	0.074
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	–	0.004	0.015	0.104	0.144	0.183
Electricity Trade[5]		0.004	–	–0.001	0.007	–	–	–
Shares (%)								
Coal		*7.9*	*22.7*	*15.5*	*14.6*	*12.1*	*10.1*	*8.9*
Peat		*14.2*	*12.3*	*8.4*	*7.5*	*5.0*	*3.4*	*2.9*
Oil		*77.1*	*46.6*	*52.2*	*54.8*	*51.4*	*52.4*	*51.8*
Gas		–	*17.9*	*22.1*	*21.1*	*28.6*	*31.0*	*33.3*
Comb. Renewables & Wastes		–	–	*1.3*	*1.1*	*1.7*	*1.8*	*1.7*
Nuclear		–	–	–	–	–	–	–
Hydro		*0.8*	*0.6*	*0.5*	*0.6*	*0.5*	*0.4*	*0.4*
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other		–	–	–	*0.1*	*0.7*	*0.8*	*1.0*
Electricity Trade		*0.1*	–	–	*0.1*	–	–	–

0 is negligible. – is nil. .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**5.416**	**7.732**	**9.333**	**9.957**	**11.805**	**13.528**	**14.823**
Coal[1]	0.520	1.137	0.535	0.503	0.212	0.152	0.090
Peat	0.408	0.427	0.248	0.240	0.233	0.178	0.160
Oil	3.856	4.149	5.637	6.144	7.474	8.729	9.478
Gas	0.103	0.998	1.336	1.421	1.569	1.812	2.135
Comb. Renewables & Wastes[2]	–	–	0.141	0.130	0.130	0.130	0.130
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.529	1.021	1.435	1.519	2.162	2.502	2.805
Heat	–	–	–	–	0.025	0.025	0.025
Shares (%)							
Coal	*9.6*	*14.7*	*5.7*	*5.1*	*1.8*	*1.1*	*0.6*
Peat	*7.5*	*5.5*	*2.7*	*2.4*	*2.0*	*1.3*	*1.1*
Oil	*71.2*	*53.7*	*60.4*	*61.7*	*63.3*	*64.5*	*63.9*
Gas	*1.9*	*12.9*	*14.3*	*14.3*	*13.3*	*13.4*	*14.4*
Comb. Renewables & Wastes	–	–	*1.5*	*1.3*	*1.1*	*1.0*	*0.9*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*9.8*	*13.2*	*15.4*	*15.3*	*18.3*	*18.5*	*18.9*
Heat	–	–	–	–	*0.2*	*0.2*	*0.2*
TOTAL INDUSTRY[6]	**1.920**	**2.324**	**2.643**	**2.659**	**2.308**	**2.445**	**2.559**
Coal[1]	0.044	0.272	0.092	0.080	0.107	0.152	0.150
Peat	–	–	–	–	–	–	–
Oil	1.662	0.879	1.038	1.021	0.576	0.527	0.500
Gas	0.025	0.787	0.845	0.857	0.673	0.678	0.700
Comb. Renewables & Wastes[2]	–	–	0.099	0.091	0.087	0.087	0.087
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.189	0.386	0.569	0.609	0.865	1.001	1.122
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*2.3*	*11.7*	*3.5*	*3.0*	*4.6*	*6.2*	*5.9*
Peat	–	–	–	–	–	–	–
Oil	*86.6*	*37.8*	*39.3*	*38.4*	*25.0*	*21.6*	*19.5*
Gas	*1.3*	*33.9*	*32.0*	*32.2*	*29.2*	*27.7*	*27.4*
Comb. Renewables & Wastes	–	–	*3.7*	*3.4*	*3.8*	*3.6*	*3.4*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*9.8*	*16.6*	*21.5*	*22.9*	*37.5*	*40.9*	*43.8*
Heat	–	–	–	–	–	–	–
TRANSPORT[7]	**1.406**	**2.031**	**2.904**	**3.372**	**4.622**	**5.610**	**6.322**
TOTAL OTHER SECTORS[8]	**2.090**	**3.377**	**3.787**	**3.927**	**4.875**	**5.473**	**5.942**
Coal[1]	0.476	0.865	0.443	0.422	0.105	–	–0.060
Peat	0.408	0.427	0.248	0.240	0.233	0.178	0.160
Oil	0.788	1.240	1.698	1.754	2.278	2.595	2.659
Gas	0.078	0.211	0.492	0.564	0.896	1.134	1.435
Comb. Renewables & Wastes[2]	–	–	0.041	0.039	0.043	0.043	0.043
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.340	0.634	0.865	0.908	1.295	1.498	1.680
Heat	–	–	–	–	0.025	0.025	0.025
Shares (%)							
Coal	*22.8*	*25.6*	*11.7*	*10.7*	*2.2*	–	*–1.0*
Peat	*19.5*	*12.6*	*6.5*	*6.1*	*4.8*	*3.3*	*2.7*
Oil	*37.7*	*36.7*	*44.8*	*44.7*	*46.7*	*47.4*	*44.7*
Gas	*3.7*	*6.2*	*13.0*	*14.4*	*18.4*	*20.7*	*24.2*
Comb. Renewables & Wastes	–	–	*1.1*	*1.0*	*0.9*	*0.8*	*0.7*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*16.3*	*18.8*	*22.8*	*23.1*	*26.6*	*27.4*	*28.3*
Heat	–	–	–	–	*0.5*	*0.5*	*0.4*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**1.766**	**3.145**	**4.348**	**4.599**	**5.623**	**6.058**	**6.489**
OUTPUT (Mtoe)	**0.632**	**1.224**	**1.694**	**1.796**	**2.539**	**2.908**	**3.248**
(TWh gross)	7.348	14.229	19.697	20.882	29.522	33.811	37.772
Output Shares (%)							
Coal	*1.0*	*41.6*	*34.4*	*32.2*	*27.5*	*23.0*	*20.3*
Peat	*23.9*	*15.8*	*10.5*	*8.1*	*4.4*	*2.9*	*2.4*
Oil	*66.3*	*10.0*	*17.6*	*23.2*	*5.6*	*3.0*	*1.3*
Gas	–	*27.7*	*33.4*	*30.8*	*54.8*	*62.4*	*66.9*
Comb. Renewables & Wastes	–	–	*0.5*	*0.4*	*1.6*	*1.8*	*1.8*
Nuclear	–	–	–	–	–	–	–
Hydro	*8.8*	*4.9*	*3.4*	*4.4*	*2.8*	*2.5*	*2.3*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.3*	*0.8*	*3.4*	*4.4*	*5.1*
TOTAL LOSSES	**1.649**	**2.260**	**3.101**	**3.274**	**3.629**	**3.741**	**3.880**
of which:							
Electricity and Heat Generation[10]	1.134	1.921	2.654	2.802	3.074	3.140	3.229
Other Transformation	0.329	0.041	0.057	0.063	0.111	0.109	0.107
Own Use and Losses[11]	0.186	0.298	0.390	0.409	0.444	0.492	0.544
Statistical Differences	**0.124**	**0.472**	**0.094**	**0.019**	–	–	–

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	23.17	45.53	73.40	81.06	111.57	137.45	160.89
Population (millions)	3.07	3.50	3.66	3.71	3.96	4.17	4.32
TPES/GDP[12]	0.31	0.23	0.17	0.16	0.14	0.13	0.12
Energy Production/TPES	0.16	0.32	0.23	0.19	0.21	0.16	0.15
Per Capita TPES[13]	2.34	2.99	3.42	3.58	3.90	4.14	4.33
Oil Supply/GDP[12]	0.24	0.11	0.09	0.09	0.07	0.07	0.06
TFC/GDP[12]	0.23	0.17	0.13	0.12	0.11	0.10	0.09
Per Capita TFC[13]	1.76	2.21	2.55	2.69	2.98	3.25	3.43
Energy-related CO_2 Emissions (Mt CO_2)[14]	23.2	33.2	37.7	39.7	44.2	48.5	51.9
CO_2 Emissions from Bunkers (Mt CO_2)	0.3	0.1	0.5	0.5	0.1	0.2	0.1

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	3.6	1.5	2.6	5.8	2.2	2.3	1.6
Coal	6.9	9.9	–2.8	–0.1	–0.6	–1.4	–0.8
Peat	2.1	1.0	–2.8	–5.6	–3.4	–5.3	–2.0
Oil	2.3	–2.4	4.3	11.1	1.3	2.7	1.4
Gas	–	13.6	5.8	1.1	6.7	3.9	3.1
Comb. Renewables & Wastes	–	–	–	–6.2	8.0	3.1	1.4
Nuclear	–	–	–	–	–	–	–
Hydro	4.3	–1.5	–0.5	36.2	–1.5	0.6	0.3
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	275.0	28.5	7.9	5.5
TFC	4.3	0.9	2.7	6.7	2.5	2.8	1.8
Electricity Consumption	5.8	2.9	5.0	5.9	5.2	3.0	2.3
Energy Production	4.6	7.8	–2.2	–14.1	4.2	–3.1	0.0
Net Oil Imports	2.9	–2.0	3.9	11.1	1.0	2.7	1.4
GDP	4.9	3.6	7.1	10.4	4.7	4.3	3.2
Growth in the TPES/GDP Ratio	–1.3	–2.0	–4.2	–4.2	–2.4	–1.9	–1.5
Growth in the TFC/GDP Ratio	–0.6	–2.6	–4.1	–3.4	–2.1	–1.4	–1.3

Please note: Rounding may cause totals to differ from the sum of the elements.

ITALY

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**20.1**	**24.8**	**29.3**	**29.0**	**31.3**	**33.3**	**..**
Coal[1]		0.3	0.3	0.0	0.0	0.2	0.2	..
Oil		1.1	4.8	6.2	5.9	5.8	5.5	..
Gas		12.6	14.0	15.8	15.6	13.6	12.4	..
Comb. Renewables & Wastes[2]		0.2	0.9	1.2	1.3	4.5	7.0	..
Nuclear		0.8	–	–	–	–	–	..
Hydro		3.2	2.7	3.6	3.5	3.8	3.9	..
Geothermal		1.8	2.0	2.5	2.6	2.6	2.8	..
Solar/Wind/Other[3]		–	0.0	0.1	0.1	0.9	1.6	..
TOTAL NET IMPORTS[4]		**109.3**	**130.4**	**133.0**	**138.6**	**142.6**	**152.5**	**..**
Coal[1]	Exports	0.4	0.1	0.1	0.1	..	..	..
	Imports	8.2	13.9	10.8	11.7	11.7	12.3	..
	Net Imports	7.7	13.7	10.7	11.6	11.7	12.3	..
Oil	Exports	29.4	20.1	21.5	23.4	..	..	..
	Imports	136.4	111.1	110.5	114.3	85.3	83.0	..
	Bunkers	7.1	2.7	2.4	2.7	2.4	2.4	..
	Net Imports	99.9	88.3	86.6	88.3	82.9	80.6	..
Gas	Exports	–	0.0	0.0	0.0	..	..	..
	Imports	1.6	25.3	32.0	34.9	48.1	59.6	..
	Net Imports	1.6	25.3	32.0	34.9	48.1	59.6	..
Electricity	Exports	0.2	0.1	0.1	0.1	..	..	..
	Imports	0.3	3.1	3.4	3.6	..	..	..
	Net Imports	0.1	3.0	3.3	3.5	..	..	..
TOTAL STOCK CHANGES		**–0.9**	**–1.9**	**1.0**	**0.2**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**128.6**	**153.3**	**163.3**	**167.9**	**173.9**	**185.8**	**..**
Coal[1]		8.1	14.6	11.3	11.8	11.9	12.5	..
Oil		100.1	91.0	93.5	93.6	88.6	86.1	..
Gas		14.2	39.0	47.5	51.1	61.7	72.0	..
Comb. Renewables & Wastes[2]		0.2	1.0	1.6	1.7	4.5	7.0	..
Nuclear		0.8	–	–	–	–	–	..
Hydro		3.2	2.7	3.6	3.5	3.8	3.9	..
Geothermal		1.8	2.0	2.5	2.6	2.6	2.8	..
Solar/Wind/Other[3]		–	0.0	0.1	0.1	0.9	1.6	..
Electricity Trade[5]		0.1	3.0	3.3	3.5	–	–	..
Shares (%)								
Coal		*6.3*	*9.5*	*6.9*	*7.0*	*6.8*	*6.7*	..
Oil		*77.9*	*59.3*	*57.3*	*55.7*	*51.0*	*46.4*	..
Gas		*11.1*	*25.4*	*29.1*	*30.4*	*35.5*	*38.8*	..
Comb. Renewables & Wastes		*0.2*	*0.6*	*1.0*	*1.0*	*2.6*	*3.8*	..
Nuclear		*0.6*	–	–	–	–	–	..
Hydro		*2.5*	*1.8*	*2.2*	*2.1*	*2.2*	*2.1*	..
Geothermal		*1.4*	*1.3*	*1.5*	*1.6*	*1.5*	*1.5*	..
Solar/Wind/Other		–	–	–	*0.1*	*0.5*	*0.8*	..
Electricity Trade		*0.1*	*1.9*	*2.0*	*2.1*	–	–	..

0 is negligible, – is nil, .. is not available.

Please note: Forecast data for 2010 are based on the 1998 submission and data for 2005 are IEA Secretariat estimates.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**98.7**	**117.6**	**125.6**	**128.9**	**130.0**	**133.8**	**..**
Coal[1]	3.3	3.4	2.7	2.5	2.5	2.4	..
Oil	72.1	64.2	64.8	65.8	63.5	63.0	..
Gas	12.8	30.6	35.4	37.1	37.2	38.0	..
Comb. Renewables & Wastes[2]	–	0.8	1.2	1.2	1.9	2.4	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	0.0	0.0	0.0	0.1	0.2	..
Electricity	10.6	18.5	21.3	21.9	24.6	27.4	..
Heat	–	0.2	0.2	0.2	0.3	0.4	..
Shares (%)							
Coal	*3.3*	*2.9*	*2.2*	*2.0*	*1.9*	*1.8*	..
Oil	*73.0*	*54.6*	*51.6*	*51.0*	*48.8*	*47.1*	..
Gas	*12.9*	*26.0*	*28.1*	*28.8*	*28.6*	*28.4*	..
Comb. Renewables & Wastes	–	*0.7*	*0.9*	*1.0*	*1.5*	*1.8*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	*0.1*	..
Electricity	*10.7*	*15.7*	*17.0*	*17.0*	*18.9*	*20.5*	..
Heat	–	*0.2*	*0.2*	*0.2*	*0.2*	*0.3*	..
TOTAL INDUSTRY[6]	**47.6**	**44.6**	**45.1**	**45.3**	**44.8**	**45.5**	**..**
Coal[1]	2.6	3.3	2.6	2.5	2.4	2.3	..
Oil	29.7	16.9	15.6	15.3	13.7	12.7	..
Gas	8.7	14.6	16.0	16.3	15.9	15.9	..
Comb. Renewables & Wastes[2]	–	0.2	0.2	0.3	0.6	0.9	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	6.6	9.5	10.6	10.9	12.3	13.7	..
Heat	–	–	–	–	–	–	..
Shares (%)							
Coal	*5.6*	*7.3*	*5.8*	*5.5*	*5.3*	*5.0*	..
Oil	*62.3*	*37.9*	*34.7*	*33.9*	*30.4*	*27.9*	..
Gas	*18.2*	*32.9*	*35.4*	*35.9*	*35.5*	*35.0*	..
Comb. Renewables & Wastes	–	*0.5*	*0.5*	*0.6*	*1.3*	*2.0*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*13.9*	*21.4*	*23.6*	*24.1*	*27.4*	*30.1*	..
Heat	–	–	–	–	–	–	..
TRANSPORT[7]	**20.5**	**35.3**	**40.6**	**41.8**	**41.2**	**41.7**	**..**
TOTAL OTHER SECTORS[8]	**30.6**	**37.8**	**40.0**	**41.8**	**44.0**	**46.7**	**..**
Coal[1]	0.5	0.1	0.1	0.1	0.1	0.2	..
Oil	22.5	12.8	9.5	9.7	10.0	10.3	..
Gas	4.0	15.7	19.1	20.6	20.7	21.3	..
Comb. Renewables & Wastes[2]	–	0.6	1.0	1.0	1.3	1.5	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	0.0	0.0	0.0	0.1	0.2	..
Electricity	3.6	8.3	10.0	10.3	11.5	12.8	..
Heat	–	0.2	0.2	0.2	0.3	0.4	..
Shares (%)							
Coal	*1.5*	*0.3*	*0.3*	*0.2*	*0.3*	*0.3*	..
Oil	*73.5*	*33.9*	*23.8*	*23.1*	*22.7*	*22.1*	..
Gas	*13.1*	*41.6*	*47.8*	*49.2*	*47.1*	*45.7*	..
Comb. Renewables & Wastes	–	*1.6*	*2.4*	*2.4*	*3.0*	*3.2*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	*0.1*	*0.4*	..
Electricity	*11.8*	*22.1*	*25.1*	*24.6*	*26.1*	*27.4*	..
Heat	–	*0.5*	*0.5*	*0.5*	*0.7*	*0.9*	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**27.6**	**42.4**	**46.8**	**48.4**	**59.7**	**70.6**	**..**
OUTPUT (Mtoe)	**12.4**	**18.3**	**21.2**	**21.8**	**28.0**	**31.6**	**..**
(TWh gross)	143.9	213.2	246.5	253.6	325.0	367.5	..
Output Shares (%)							
Coal	*3.6*	*16.8*	*10.0*	*11.0*	*9.8*	*9.2*	..
Oil	*62.4*	*48.2*	*46.0*	*42.3*	*29.2*	*22.0*	..
Gas	*3.1*	*18.6*	*24.9*	*27.9*	*38.5*	*43.6*	..
Comb. Renewables & Wastes	*0.9*	*0.1*	*0.3*	*0.5*	*4.6*	*7.6*	..
Nuclear	*2.2*	–	–	–	–	–	..
Hydro	*26.1*	*14.8*	*16.9*	*16.3*	*13.5*	*12.2*	..
Geothermal	*1.7*	*1.5*	*1.6*	*1.7*	*1.2*	*1.1*	..
Solar/Wind/Other	–	*0.0*	*0.3*	*0.4*	*3.1*	*4.3*	..
TOTAL LOSSES	**29.5**	**35.8**	**37.7**	**39.0**	**43.9**	**52.0**	**..**
of which:							
Electricity and Heat Generation[10]	15.3	23.9	25.4	26.4	31.4	38.6	..
Other Transformation	6.0	2.7	2.5	2.5	2.4	2.4	..
Own Use and Losses[11]	8.3	9.2	9.8	10.2	10.1	11.0	..
Statistical Differences	**0.3**	**–0.0**	**–0.0**	**0.0**	**–**	**–**	**–**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	688.66	1093.95	1181.92	1198.78	1377.02	1520.34	..
Population (millions)	54.75	56.74	56.87	56.98	57.15	57.00	..
TPES/GDP[12]	0.19	0.14	0.14	0.14	0.13	0.12	..
Energy Production/TPES	0.16	0.16	0.18	0.17	0.18	0.18	..
Per Capita TPES[13]	2.35	2.70	2.87	2.95	3.04	3.26	..
Oil Supply/GDP[12]	0.15	0.08	0.08	0.08	0.06	0.06	..
TFC/GDP[12]	0.14	0.11	0.11	0.11	0.09	0.09	..
Per Capita TFC[13]	1.80	2.07	2.21	2.26	2.27	2.35	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	348.2	408.2	424.4	434.8	444.9	464.1	..
CO_2 Emissions from Bunkers (Mt CO_2)	22.6	8.4	7.5	8.3	7.5	7.5	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	1.5	0.8	0.9	2.8	0.5	1.3	..
Coal	4.3	3.1	–3.6	3.9	0.1	1.1	..
Oil	–0.0	–0.8	0.4	0.1	–0.8	–0.6	..
Gas	8.1	5.1	2.9	7.7	2.7	3.1	..
Comb. Renewables & Wastes	23.4	1.2	6.9	7.7	14.9	9.5	..
Nuclear	–2.9	–	–	–	–	–	..
Hydro	3.4	–3.3	4.0	–0.9	0.9	0.4	..
Geothermal	0.1	1.2	2.6	7.2	–0.1	1.1	..
Solar/Wind/Other	–	–	47.8	18.2	39.2	11.0	..
TFC	1.3	0.9	0.9	2.6	0.1	0.6	..
Electricity Consumption	4.0	3.0	2.1	2.8	1.6	2.2	..
Energy Production	0.2	1.8	2.4	–0.9	1.1	1.2	..
Net Oil Imports	–0.4	–0.9	–0.3	1.9	–0.9	–0.6	..
GDP	3.5	2.3	1.1	1.4	2.0	2.0	..
Growth in the TPES/GDP Ratio	–1.9	–1.5	–0.2	1.4	–1.5	–0.7	..
Growth in the TFC/GDP Ratio	–2.1	–1.4	–0.2	1.2	–1.8	–1.4	..

Please note: Rounding may cause totals to differ from the sum of the elements.

JAPAN

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**29.5**	**75.6**	**107.0**	**110.0**	**..**	**163.7**	**..**
Coal[1]		17.9	4.6	2.4	2.0	..	2.9	..
Oil		0.8	0.6	0.8	0.8	..	0.7	..
Gas		2.3	1.8	2.0	2.0	..	2.0	..
Comb. Renewables & Wastes[2]		–	6.7	7.5	7.3	..	11.9	..
Nuclear		2.5	52.7	83.2	86.6	..	125.1	..
Hydro		5.7	7.7	7.7	8.0	..	9.0	..
Geothermal		0.2	1.5	3.5	3.3	..	11.5	..
Solar/Wind/Other[3]		–	–	0.0	0.0	..	0.5	..
TOTAL NET IMPORTS[4]		**300.7**	**364.2**	**414.2**	**395.5**	**..**	**376.2**	**..**
Coal[1]	Exports	0.4	1.0	1.8	1.7	..	1.7	..
	Imports	41.3	70.0	85.0	84.3	..	77.6	..
	Net Imports	40.9	69.0	83.2	82.7	..	75.9	..
Oil	Exports	2.9	3.8	8.8	6.6	..	14.5	..
	Imports	276.7	262.6	289.5	267.3	..	255.0	..
	Bunkers	16.8	5.1	5.1	5.5	..	5.0	..
	Net Imports	257.0	253.6	275.7	255.2	..	235.5	..
Gas	Exports	–	–	–	–	..	–	..
	Imports	2.8	41.7	55.3	57.6	..	64.8	..
	Net Imports	2.8	41.7	55.3	57.6	..	64.8	..
Electricity	Exports	–	–	–	–	..	–	..
	Imports	–	–	–	–	..	–	..
	Net Imports	–	–	–	–	..	–	..
TOTAL STOCK CHANGES		**–6.6**	**–1.0**	**–3.5**	**4.6**	**..**	**–**	**..**
TOTAL SUPPLY (TPES)		**323.6**	**438.8**	**517.7**	**510.1**	**..**	**539.9**	**..**
Coal[1]		57.9	74.0	86.5	84.6	..	78.9	..
Oil		252.2	252.9	272.1	260.8	..	236.2	..
Gas		5.1	43.3	57.2	59.6	..	66.8	..
Comb. Renewables & Wastes[2]		–	6.7	7.5	7.3	..	11.9	..
Nuclear		2.5	52.7	83.2	86.6	..	125.1	..
Hydro		5.7	7.7	7.7	8.0	..	9.0	..
Geothermal		0.2	1.5	3.5	3.3	..	11.5	..
Solar/Wind/Other[3]		–	–	0.0	0.0	..	0.5	..
Electricity Trade[5]		–	–	–	–	..	–	..
Shares (%)								
Coal		*17.9*	*16.9*	*16.7*	*16.6*	..	*14.6*	..
Oil		*77.9*	*57.6*	*52.6*	*51.1*	..	*43.8*	..
Gas		*1.6*	*9.9*	*11.1*	*11.7*	..	*12.4*	..
Comb. Renewables & Wastes		–	*1.5*	*1.4*	*1.4*	..	*2.2*	..
Nuclear		*0.8*	*12.0*	*16.1*	*17.0*	..	*23.2*	..
Hydro		*1.8*	*1.8*	*1.5*	*1.6*	..	*1.7*	..
Geothermal		*0.1*	*0.3*	*0.7*	*0.6*	..	*2.1*	..
Solar/Wind/Other		–	–	–	–	..	*0.1*	..
Electricity Trade		–	–	–	–	..	–	..

0 is negligible. – is nil. .. is not available.

Please note: In 2010, data for combustible renewables and wastes, electricity generated, production and imports of coal, oil and gas, and bunkers are IEA Secretariat estimates.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**234.4**	**294.5**	**340.1**	**336.5**	**..**	**340.6**	**..**
Coal[1]	20.2	22.5	21.6	19.4	..	21.2	..
Oil	171.5	188.3	215.0	212.2	..	191.4	..
Gas	7.0	14.7	20.7	21.2	..	27.6	..
Comb. Renewables & Wastes[2]	–	3.7	3.6	3.4	..	7.1	..
Geothermal	–	–	0.3	0.3	..	0.7	..
Solar/Wind/Other	–	–	–	–	..	–	..
Electricity	35.7	65.1	78.6	79.6	..	91.7	..
Heat	0.0	0.2	0.4	0.5	..	0.9	..
Shares (%)							
Coal	*8.6*	*7.6*	*6.4*	*5.8*	..	*6.2*	..
Oil	*73.2*	*63.9*	*63.2*	*63.1*	..	*56.2*	..
Gas	*3.0*	*5.0*	*6.1*	*6.3*	..	*8.1*	..
Comb. Renewables & Wastes	–	*1.3*	*1.0*	*1.0*	..	*2.1*	..
Geothermal	–	–	*0.1*	*0.1*	..	*0.2*	..
Solar/Wind/Other	–	–	–	–	..	–	..
Electricity	*15.2*	*22.1*	*23.1*	*23.7*	..	*26.9*	..
Heat	–	*0.1*	*0.1*	*0.1*	..	*0.3*	..
TOTAL INDUSTRY[6]	**140.2**	**134.5**	**146.1**	**141.0**	**..**	**155.9**	**..**
Coal[1]	18.2	21.7	20.6	18.4	..	19.9	..
Oil	94.9	73.3	79.3	77.0	..	80.6	..
Gas	2.1	4.6	8.2	8.4	..	9.8	..
Comb. Renewables & Wastes[2]	–	2.5	2.3	2.1	..	2.9	..
Geothermal	–	–	0.1	0.1	..	0.4	..
Solar/Wind/Other	–	–	–	–	..	–	..
Electricity	25.1	32.4	35.7	35.0	..	42.4	..
Heat	–	–	–	–	..	–	..
Shares (%)							
Coal	*13.0*	*16.2*	*14.1*	*13.1*	..	*12.7*	..
Oil	*67.7*	*54.4*	*54.3*	*54.6*	..	*51.7*	..
Gas	*1.5*	*3.4*	*5.6*	*5.9*	..	*6.3*	..
Comb. Renewables & Wastes	–	*1.8*	*1.5*	*1.5*	..	*1.8*	..
Geothermal	–	–	*0.1*	*0.1*	..	*0.3*	..
Solar/Wind/Other	–	–	–	–	..	–	..
Electricity	*17.9*	*24.1*	*24.4*	*24.8*	..	*27.2*	..
Heat	–	–	–	–	..	–	..
TRANSPORT[7]	**42.6**	**74.3**	**92.1**	**92.5**	**..**	**83.2**	**..**
TOTAL OTHER SECTORS[8]	**51.6**	**85.7**	**102.0**	**103.1**	**..**	**101.5**	**..**
Coal[1]	1.8	0.8	1.0	1.0	..	1.3	..
Oil	35.3	42.5	45.5	44.6	..	33.3	..
Gas	5.0	10.1	12.6	12.9	..	14.2	..
Comb. Renewables & Wastes[2]	–	1.2	1.3	1.3	..	4.2	..
Geothermal	–	–	0.1	0.1	..	0.3	..
Solar/Wind/Other	–	–	–	–	..	–	..
Electricity	9.5	30.9	41.0	42.7	..	47.2	..
Heat	0.0	0.2	0.4	0.5	..	0.9	..
Shares (%)							
Coal	*3.4*	*0.9*	*1.0*	*1.0*	..	*1.3*	..
Oil	*68.5*	*49.6*	*44.6*	*43.3*	..	*32.9*	..
Gas	*9.6*	*11.8*	*12.4*	*12.5*	..	*14.0*	..
Comb. Renewables & Wastes	–	*1.4*	*1.3*	*1.3*	..	*4.1*	..
Geothermal	–	–	*0.1*	*0.1*	..	*0.3*	..
Solar/Wind/Other	–	–	–	–	..	–	..
Electricity	*18.4*	*36.1*	*40.2*	*41.4*	..	*46.6*	..
Heat	*0.1*	*0.2*	*0.4*	*0.5*	..	*0.9*	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**90.6**	**170.6**	**214.0**	**213.5**	**..**	**252.0**	**..**
OUTPUT (Mtoe)	**40.0**	**73.2**	**88.3**	**89.1**	**..**	**101.5**	**..**
(TWh gross)	465.4	850.8	1027.3	1036.2	..	1180.0	..
Output Shares (%)							
Coal	*8.0*	*14.5*	*19.0*	*19.1*	..	*15.2*	..
Oil	*73.2*	*29.7*	*18.2*	*16.4*	..	*11.2*	..
Gas	*2.3*	*19.4*	*20.5*	*21.1*	..	*20.2*	..
Comb. Renewables & Wastes	–	*2.0*	*2.1*	*2.1*	..	*2.3*	..
Nuclear	*2.1*	*23.8*	*31.1*	*32.1*	..	*40.7*	..
Hydro	*14.3*	*10.5*	*8.7*	*8.9*	..	*8.9*	..
Geothermal	*0.1*	*0.2*	*0.4*	*0.3*	..	*1.1*	..
Solar/Wind/Other	–	*0.0*	*0.0*	*0.0*	..	*0.5*	..
TOTAL LOSSES	**94.6**	**143.2**	**176.6**	**175.3**	**..**	**199.3**	**..**
of which:							
Electricity and Heat Generation[10]	50.5	97.2	125.2	123.9	..	149.5	..
Other Transformation	25.1	23.3	24.8	25.0	..	27.1	..
Own Use and Losses[11]	19.0	22.7	26.7	26.4	..	22.6	..
Statistical Differences	**–5.4**	**1.2**	**1.0**	**–1.7**	**..**	**–**	**..**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	1590.43	2970.09	3399.44	3303.58	3980.87	4503.99	..
Population (millions)	108.66	123.61	126.17	126.49	128.89	130.40	..
TPES/GDP[12]	0.20	0.15	0.15	0.15	..	0.12	..
Energy Production/TPES	0.09	0.17	0.21	0.22	..	0.30	..
Per Capita TPES[13]	2.98	3.55	4.10	4.03	..	4.14	..
Oil Supply/GDP[12]	0.16	0.09	0.08	0.08	..	0.05	..
TFC/GDP[12]	0.15	0.10	0.10	0.10	..	0.08	..
Per Capita TFC[13]	2.16	2.38	2.70	2.66	..	2.61	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	910.2	1061.8	1179.5	1147.2	..	1073.8	..
CO_2 Emissions from Bunkers (Mt CO_2)	53.5	16.3	16.2	17.6	..	16.1	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	1.5	2.0	2.4	–1.5	..	..	..
Coal	–2.0	3.4	2.3	–2.2	..	..	..
Oil	0.4	–0.2	1.0	–4.2	..	..	..
Gas	24.2	8.0	4.1	4.1	..	..	..
Comb. Renewables & Wastes	–	–	1.5	–2.2	..	..	..
Nuclear	39.1	10.1	6.7	4.1	..	..	..
Hydro	3.2	0.9	0.1	3.1	..	..	..
Geothermal	22.3	6.2	12.8	–5.6	..	..	..
Solar/Wind/Other	–	–	–	100.0	..	..	..
TFC	1.0	1.6	2.1	–1.1	..	..	..
Electricity Consumption	3.9	3.4	2.7	1.3	..	..	..
Energy Production	4.9	6.1	5.1	2.8	..	..	..
Net Oil Imports	0.5	–0.4	1.2	–7.4	..	..	..
GDP	3.5	3.9	1.9	–2.8	2.7	2.5	..
Growth in the TPES/GDP Ratio	–1.9	–1.9	0.4	1.4	..	..	..
Growth in the TFC/GDP Ratio	–2.4	–2.2	0.1	1.8	..	..	..

Please note: Rounding may cause totals to differ from the sum of the elements.

NEW ZEALAND

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**4.05**	**12.18**	**14.79**	**13.84**	**15.33**	**16.05**	**17.31**
Coal[1]		1.29	1.39	1.95	1.91	3.03	3.16	3.44
Oil		0.18	2.11	3.18	2.57	2.15	2.15	2.15
Gas		0.28	3.87	4.71	4.15	3.10	2.97	3.11
Comb. Renewables & Wastes[2]		–	0.62	0.64	0.66	1.32	1.56	1.84
Nuclear		–	–	–	–	–	–	–
Hydro		1.23	2.01	2.05	2.10	2.27	2.27	2.30
Geothermal		1.07	2.17	2.26	2.45	3.45	3.92	4.43
Solar/Wind/Other[3]		–	–	0.00	0.00	0.01	0.03	0.05
TOTAL NET IMPORTS[4]		**4.27**	**2.03**	**2.48**	**3.29**	**2.95**	**4.56**	**5.26**
Coal[1]	Exports	0.02	0.23	0.87	0.77	1.16	1.16	1.16
	Imports	–	0.01	–	–	–	–	–
	Net Imports	–0.02	–0.22	–0.87	–0.77	–1.16	–1.16	–1.16
Oil	Exports	–	1.47	1.99	1.85	–	–	–
	Imports	4.60	4.04	5.69	6.24	4.47	6.10	6.83
	Bunkers	0.31	0.32	0.34	0.33	0.37	0.39	0.41
	Net Imports	4.29	2.25	3.35	4.06	4.10	5.71	6.42
Gas	Exports	–	–	–	–	–	–	–
	Imports	–	–	–	–	–	–	–
	Net Imports	–	–	–	–	–	–	–
Electricity	Exports	–	–	–	–	–	–	–
	Imports	–	–	–	–	–	–	–
	Net Imports	–	–	–	–	–	–	–
TOTAL STOCK CHANGES		**–0.05**	**–0.05**	**0.10**	**0.03**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**8.27**	**14.15**	**17.37**	**17.16**	**18.27**	**20.61**	**22.56**
Coal[1]		1.26	1.13	1.28	1.21	1.87	2.00	2.28
Oil		4.42	4.35	6.44	6.60	6.25	7.86	8.56
Gas		0.28	3.87	4.71	4.15	3.10	2.97	3.11
Comb. Renewables & Wastes[2]		–	0.62	0.64	0.66	1.32	1.56	1.84
Nuclear		–	–	–	–	–	–	–
Hydro		1.23	2.01	2.05	2.10	2.27	2.27	2.30
Geothermal		1.07	2.17	2.26	2.45	3.45	3.92	4.43
Solar/Wind/Other[3]		–	–	0.00	0.00	0.01	0.03	0.05
Electricity Trade[5]		–	–	–	–	–	–	–
Shares (%)								
Coal		*15.3*	*8.0*	*7.3*	*7.0*	*10.3*	*9.7*	*10.1*
Oil		*53.5*	*30.7*	*37.0*	*38.4*	*34.2*	*38.1*	*38.0*
Gas		*3.4*	*27.4*	*27.1*	*24.2*	*17.0*	*14.4*	*13.8*
Comb. Renewables & Wastes		–	*4.4*	*3.7*	*3.9*	*7.2*	*7.6*	*8.1*
Nuclear		–	–	–	–	–	–	–
Hydro		*14.9*	*14.2*	*11.8*	*12.2*	*12.4*	*11.0*	*10.2*
Geothermal		*12.9*	*15.4*	*13.0*	*14.2*	*18.9*	*19.0*	*19.6*
Solar/Wind/Other		–	–	–	–	*0.1*	*0.1*	*0.2*
Electricity Trade		–	–	–	–	–	–	–

0 is negligible, – is nil, .. is not available.

Please note: Forecast data refer to the fiscal year.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**6.05**	**9.91**	**12.28**	**12.25**	**13.87**	**14.44**	**15.62**
Coal[1]	0.87	1.01	0.87	0.87	1.00	1.04	1.06
Oil	3.67	4.43	5.45	5.46	6.85	7.48	8.16
Gas	0.14	1.30	2.47	2.40	1.78	1.30	1.39
Comb. Renewables & Wastes[2]	–	0.51	0.50	0.53	0.78	0.84	0.90
Geothermal	–	0.27	0.32	0.31	0.38	0.40	0.44
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	1.37	2.39	2.67	2.68	3.10	3.39	3.68
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*14.4*	*10.2*	*7.1*	*7.1*	*7.2*	*7.2*	*6.8*
Oil	*60.6*	*44.7*	*44.4*	*44.5*	*49.3*	*51.8*	*52.2*
Gas	*2.4*	*13.1*	*20.1*	*19.6*	*12.8*	*9.0*	*8.9*
Comb. Renewables & Wastes	–	*5.1*	*4.1*	*4.3*	*5.6*	*5.8*	*5.8*
Geothermal	–	*2.7*	*2.6*	*2.6*	*2.7*	*2.8*	*2.8*
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*22.6*	*24.1*	*21.8*	*21.9*	*22.3*	*23.5*	*23.5*
Heat	–	–	–	–	–	–	–
TOTAL INDUSTRY[6]	**2.18**	**4.07**	**5.24**	**5.15**	**5.22**	**4.97**	**5.25**
Coal[1]	0.69	0.86	0.72	0.75	0.79	0.83	0.85
Oil	0.96	0.59	0.60	0.52	0.63	0.66	0.69
Gas	0.05	1.06	2.24	2.18	1.45	0.95	1.02
Comb. Renewables & Wastes[2]	–	0.39	0.38	0.41	0.62	0.67	0.72
Geothermal	–	0.22	0.26	0.25	0.30	0.32	0.35
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.48	0.96	1.05	1.04	1.43	1.53	1.63
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*31.5*	*21.1*	*13.8*	*14.5*	*15.2*	*16.6*	*16.1*
Oil	*43.9*	*14.4*	*11.4*	*10.1*	*12.1*	*13.4*	*13.2*
Gas	*2.4*	*25.9*	*42.7*	*42.3*	*27.7*	*19.2*	*19.3*
Comb. Renewables & Wastes	–	*9.6*	*7.3*	*8.0*	*11.9*	*13.5*	*13.7*
Geothermal	–	*5.4*	*4.9*	*4.9*	*5.8*	*6.5*	*6.6*
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*22.2*	*23.6*	*20.0*	*20.2*	*27.4*	*30.9*	*31.0*
Heat	–	–	–	–	–	–	–
TRANSPORT[7]	**2.15**	**3.54**	**4.55**	**4.63**	**5.73**	**6.29**	**6.90**
TOTAL OTHER SECTORS[8]	**1.72**	**2.30**	**2.49**	**2.47**	**2.92**	**3.19**	**3.48**
Coal[1]	0.19	0.15	0.15	0.12	0.21	0.21	0.21
Oil	0.57	0.37	0.34	0.35	0.50	0.54	0.58
Gas	0.09	0.18	0.22	0.21	0.32	0.34	0.37
Comb. Renewables & Wastes[2]	–	0.12	0.12	0.12	0.16	0.17	0.18
Geothermal	–	0.05	0.06	0.06	0.08	0.08	0.09
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.88	1.42	1.60	1.61	1.66	1.85	2.05
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*10.7*	*6.6*	*5.9*	*5.0*	*7.0*	*6.5*	*6.1*
Oil	*32.8*	*16.0*	*13.8*	*14.1*	*17.1*	*16.9*	*16.7*
Gas	*5.3*	*7.8*	*8.7*	*8.5*	*11.1*	*10.7*	*10.7*
Comb. Renewables & Wastes	–	*5.2*	*4.8*	*4.8*	*5.3*	*5.2*	*5.2*
Geothermal	–	*2.3*	*2.5*	*2.5*	*2.6*	*2.5*	*2.5*
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*51.2*	*62.0*	*64.4*	*65.1*	*56.9*	*58.1*	*58.8*
Heat	–	–	–	–	–	–	–

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**3.16**	**5.37**	**6.60**	**6.32**	**7.74**	**8.81**	**9.84**
OUTPUT (Mtoe)	**1.59**	**2.77**	**3.18**	**3.23**	**3.62**	**3.97**	**4.29**
(TWh gross)	18.53	32.27	36.99	37.57	42.09	46.16	49.84
Output Shares (%)							
Coal	*8.5*	*1.7*	*4.4*	*3.9*	*7.7*	*7.8*	*10.0*
Oil	*6.1*	*0.0*	–	–	*0.0*	*0.1*	*0.2*
Gas	*1.4*	*17.6*	*23.7*	*23.2*	*16.5*	*19.9*	*19.2*
Comb. Renewables & Wastes	–	*1.5*	*1.4*	*1.4*	*4.8*	*5.9*	*7.0*
Nuclear	–	–	–	–	–	–	–
Hydro	*77.3*	*72.3*	*64.4*	*64.9*	*62.6*	*57.1*	*53.5*
Geothermal	*6.7*	*6.8*	*6.1*	*6.6*	*8.0*	*8.4*	*8.9*
Solar/Wind/Other	–	–	*0.0*	*0.1*	*0.3*	*0.7*	*1.1*
TOTAL LOSSES	**2.35**	**4.21**	**4.85**	**4.51**	**4.40**	**6.16**	**6.94**
of which:							
Electricity and Heat Generation[10]	1.57	2.60	3.42	3.09	4.33	5.08	5.80
Other Transformation	0.36	0.88	0.46	0.41	–0.53	0.44	0.44
Own Use and Losses[11]	0.43	0.73	0.97	1.02	0.60	0.65	0.71
Statistical Differences	**–0.13**	**0.03**	**0.24**	**0.40**	**–**	**–**	**–**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	34.46	43.10	52.40	52.01	63.96	74.15	85.96
Population (millions)	2.97	3.36	3.76	3.79	4.01	4.22	4.43
TPES/GDP[12]	0.24	0.33	0.33	0.33	0.29	0.28	0.26
Energy Production/TPES	0.49	0.86	0.85	0.81	0.84	0.78	0.77
Per Capita TPES[13]	2.78	4.21	4.62	4.53	4.55	4.89	5.09
Oil Supply/GDP[12]	0.13	0.10	0.12	0.13	0.10	0.11	0.10
TFC/GDP[12]	0.18	0.23	0.23	0.24	0.22	0.19	0.18
Per Capita TFC[13]	2.04	2.95	3.27	3.23	3.46	3.43	3.53
Energy–related CO_2 Emissions (Mt CO_2)[14]	18.3	25.4	33.1	32.3	32.2	37.4	40.9
CO_2 Emissions from Bunkers (Mt CO_2)	1.0	1.0	1.1	1.1	1.2	1.2	1.3

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	1.6	4.1	3.0	–1.2	0.9	2.4	1.8
Coal	–4.5	1.5	1.8	–5.4	6.5	1.3	2.6
Oil	–0.7	0.2	5.8	2.5	–0.8	4.7	1.7
Gas	20.0	14.8	2.8	–11.9	–4.1	–0.9	0.9
Comb. Renewables & Wastes	–	2.3	0.4	3.1	10.3	3.5	3.3
Nuclear	–	–	–	–	–	–	–
Hydro	4.6	2.0	0.3	2.2	1.1	–	0.2
Geothermal	–2.2	8.0	0.6	8.2	5.0	2.6	2.5
Solar/Wind/Other	–	–	–	300.0	17.0	19.3	10.6
TFC	2.1	3.4	3.1	–0.3	1.8	0.8	1.6
Electricity Consumption	3.0	3.5	1.6	0.2	2.1	1.8	1.6
Energy Production	4.5	7.9	2.8	–6.5	1.5	0.9	1.5
Net Oil Imports	–2.3	–4.5	5.9	21.0	0.2	6.8	2.3
GDP	0.7	1.6	2.8	–0.8	3.0	3.0	3.0
Growth in the TPES/GDP Ratio	0.8	2.4	0.1	–0.5	–2.0	–0.5	–1.1
Growth in the TFC/GDP Ratio	1.3	1.8	0.3	0.5	–1.2	–2.1	–1.4

Please note: Rounding may cause totals to differ from the sum of the elements.

NORWAY

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**8.19**	**120.14**	**212.73**	**206.67**	**..**	**..**	**..**
Coal[1]		0.29	0.20	0.26	0.22	..	..	..
Oil		1.64	84.35	160.79	153.92	..	..	..
Gas		–	24.14	41.01	41.34	..	..	..
Comb. Renewables & Wastes[2]		–	1.03	1.21	1.26	..	..	..
Nuclear		–	–	–	–	..	..	..
Hydro		6.27	10.42	9.46	9.92	..	..	..
Geothermal		–	–	–	–	..	..	..
Solar/Wind/Other[3]		–	0.00	0.00	0.00	..	..	..
TOTAL NET IMPORTS[4]		**6.48**	**–96.80**	**–188.48**	**–181.64**	**..**	**..**	**..**
Coal[1]	Exports	0.09	0.17	0.13	0.20	..	..	..
	Imports	0.67	0.84	0.92	1.04	..	..	..
	Net Imports	0.58	0.67	0.79	0.84	..	..	..
Oil	Exports	3.69	77.95	156.78	150.15	..	..	..
	Imports	10.68	4.47	5.22	5.29	..	..	..
	Bunkers	0.64	0.45	0.96	0.90	..	..	..
	Net Imports	6.35	–73.93	–152.52	–145.76	..	..	..
Gas	Exports	–	22.17	37.09	37.04	..	..	..
	Imports	–	–	–	–	..	..	..
	Net Imports	–	–22.17	–37.09	–37.04	..	..	..
Electricity	Exports	0.45	1.40	0.42	0.38	..	–	..
	Imports	0.01	0.03	0.75	0.69	..	–	..
	Net Imports	–0.45	–1.37	0.33	0.31	..	–	..
TOTAL STOCK CHANGES		**0.44**	**–1.87**	**0.14**	**0.40**	**..**	**..**	**..**
TOTAL SUPPLY (TPES)		**15.11**	**21.48**	**24.38**	**25.42**	**..**	**..**	**..**
Coal[1]		0.91	0.86	1.03	1.07	..	..	..
Oil		8.38	8.56	8.43	8.54	..	..	..
Gas		–	1.98	3.92	4.31	..	..	..
Comb. Renewables & Wastes[2]		–	1.03	1.21	1.27	..	..	..
Nuclear		–	–	–	–	..	..	..
Hydro		6.27	10.42	9.46	9.92	..	..	..
Geothermal		–	–	–	–	..	..	..
Solar/Wind/Other[3]		–	0.00	0.00	0.00	..	..	..
Electricity Trade[5]		–0.45	–1.37	0.33	0.31	..	..	..
Shares (%)								
Coal		*6.0*	*4.0*	*4.2*	*4.2*	..	..	..
Oil		*55.5*	*39.9*	*34.6*	*33.6*	..	..	..
Gas		–	*9.2*	*16.1*	*16.9*	..	..	..
Comb. Renewables & Wastes		–	*4.8*	*5.0*	*5.0*	..	..	..
Nuclear		–	–	–	–	..	..	..
Hydro		*41.5*	*48.5*	*38.8*	*39.0*	..	..	..
Geothermal		–	–	–	–	..	..	..
Solar/Wind/Other		–	–	–	–	..	..	..
Electricity Trade		*–3.0*	*–6.4*	*1.3*	*1.2*	..	..	..

0 is negligible, – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**13.73**	**18.03**	**19.43**	**20.10**	**..**	**..**	**..**
Coal[1]	0.81	0.78	0.95	1.04	..	..	..
Oil	7.68	7.96	8.38	8.46	..	..	..
Gas	0.01	–	–	–	..	..	..
Comb. Renewables & Wastes[2]	–	0.90	1.05	1.10	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	5.23	8.33	8.94	9.38	..	..	..
Heat	–	0.07	0.11	0.12	..	..	..
Shares (%)							
Coal	*5.9*	*4.3*	*4.9*	*5.2*	..	..	..
Oil	*55.9*	*44.1*	*43.1*	*42.1*	..	..	..
Gas	*0.1*	–	–	–	..	..	..
Comb. Renewables & Wastes	–	*5.0*	*5.4*	*5.5*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*38.1*	*46.2*	*46.0*	*46.7*	..	..	..
Heat	–	*0.4*	*0.6*	*0.6*	..	..	..
TOTAL INDUSTRY[6]	**6.96**	**7.90**	**7.91**	**8.35**	**..**	**..**	**..**
Coal[1]	0.76	0.77	0.95	1.03	..	..	..
Oil	3.01	2.79	2.56	2.50	..	..	..
Gas	0.00	–	–	–	..	..	..
Comb. Renewables & Wastes[2]	–	0.38	0.45	0.49	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	3.20	3.94	3.94	4.30	..	..	..
Heat	–	0.02	0.02	0.02	..	..	..
Shares (%)							
Coal	*10.9*	*9.7*	*12.0*	*12.4*	..	..	..
Oil	*43.2*	*35.3*	*32.3*	*30.0*	..	..	..
Gas	–	–	–	–	..	..	..
Comb. Renewables & Wastes	–	*4.8*	*5.6*	*5.9*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*45.9*	*49.9*	*49.8*	*51.5*	..	..	..
Heat	–	*0.2*	*0.3*	*0.2*	..	..	..
TRANSPORT[7]	**2.62**	**4.22**	**4.70**	**4.84**	**..**	**..**	**..**
TOTAL OTHER SECTORS[8]	**4.15**	**5.92**	**6.82**	**6.90**	**..**	**..**	**..**
Coal[1]	0.06	0.01	0.00	0.00	..	..	..
Oil	2.10	1.02	1.28	1.27	..	..	..
Gas	0.01	–	–	–	..	..	..
Comb. Renewables & Wastes[2]	–	0.52	0.61	0.61	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	1.98	4.31	4.84	4.92	..	..	..
Heat	–	0.06	0.09	0.10	..	..	..
Shares (%)							
Coal	*1.3*	*0.2*	–	–	..	..	..
Oil	*50.6*	*17.2*	*18.8*	*18.4*	..	..	..
Gas	*0.2*	–	–	–	..	..	..
Comb. Renewables & Wastes	–	*8.7*	*8.9*	*8.8*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*47.8*	*72.9*	*71.0*	*71.3*	..	..	..
Heat	–	*1.0*	*1.3*	*1.5*	..	..	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**6.31**	**10.59**	**9.71**	**10.18**	**..**	**..**	**..**
OUTPUT (Mtoe)	**6.28**	**10.46**	**9.52**	**9.98**	**..**	**..**	**..**
(TWh gross)	73.03	121.61	110.75	116.08	..	..	..
Output Shares (%)							
Coal	*0.0*	*0.2*	*0.2*	*0.2*	..	..	..
Oil	*0.2*	*0.0*	*0.0*	*0.0*	..	..	..
Gas	–	–	*0.2*	*0.2*	..	..	..
Comb. Renewables & Wastes	–	*0.2*	*0.2*	*0.3*	..	..	..
Nuclear	–	–	–	–	..	..	..
Hydro	*99.8*	*99.6*	*99.4*	*99.4*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	*0.0*	*0.0*	..	..	..
TOTAL LOSSES	**1.34**	**3.65**	**5.58**	**6.15**	**..**	**..**	**..**
of which:							
Electricity and Heat Generation[10]	0.03	0.04	0.04	0.05	..	..	..
Other Transformation	0.57	–0.05	–0.29	–0.18	..	..	..
Own Use and Losses[11]	0.73	3.66	5.84	6.28	..	..	..
Statistical Differences	**0.05**	**–0.20**	**–0.63**	**–0.82**	**–**	**–**	**–**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	65.65	115.45	150.96	154.14	..	..	..
Population (millions)	3.96	4.24	4.39	4.42	..	..	..
TPES/GDP[12]	0.23	0.19	0.16	0.16	..	..	..
Energy Production/TPES	0.54	5.59	8.73	8.13	..	..	..
Per Capita TPES[13]	3.82	5.06	5.55	5.75	..	..	..
Oil Supply/GDP[12]	0.13	0.07	0.06	0.06	..	..	..
TFC/GDP[12]	0.21	0.16	0.13	0.13	..	..	..
Per Capita TFC[13]	3.47	4.25	4.42	4.55	..	..	..
Energy–related CO_2 Emissions (Mt CO_2)[14]	26.5	29.8	34.2	35.9	..	..	..
CO_2 Emissions from Bunkers (Mt CO_2)	2.0	1.4	3.0	2.8	..	..	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	3.7	1.2	1.8	4.3	..	..	..
Coal	1.4	–1.3	2.5	4.1	..	..	..
Oil	1.8	–0.8	–0.2	1.4	..	..	..
Gas	–	9.8	10.3	9.8	..	..	..
Comb. Renewables & Wastes	–	5.6	2.4	4.7	..	..	..
Nuclear	–	–	–	–	..	..	..
Hydro	3.3	2.9	–1.4	4.8	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
TFC	3.5	0.6	1.1	3.4	..	..	..
Electricity Consumption	3.6	2.3	1.0	5.0	..	..	..
Energy Production	33.7	8.9	8.5	–2.8	..	..	..
Net Oil Imports	–	19.9	10.9	–4.4	..	..	..
GDP	4.8	2.6	3.9	2.1	..	..	..
Growth in the TPES/GDP Ratio	–1.0	–1.4	–2.0	2.1	..	..	..
Growth in the TFC/GDP Ratio	–1.2	–2.0	–2.7	1.3	..	..	..

Please note: Rounding may cause totals to differ from the sum of the elements.

SPAIN

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**11.3**	**34.1**	**31.5**	**31.9**	**..**	**–**	**..**
Coal[1]		6.5	11.9	9.8	9.2	..	..	..
Oil		0.7	1.2	0.4	0.5	..	..	..
Gas		0.0	1.3	0.2	0.1	..	..	..
Comb. Renewables & Wastes[2]		0.0	3.4	3.7	3.7	..	..	..
Nuclear		1.7	14.1	14.4	15.4	..	..	..
Hydro		2.5	2.2	3.0	2.9	..	..	..
Geothermal		–	–	0.0	0.0	..	..	..
Solar/Wind/Other[3]		–	0.0	0.1	0.1	..	..	..
TOTAL NET IMPORTS[4]		**42.5**	**56.6**	**75.3**	**82.6**	**..**	**–**	**..**
Coal[1]	Exports	0.0	0.0	0.1	0.3	..	..	..
	Imports	2.2	7.1	6.9	8.6	..	..	..
	Net Imports	2.2	7.1	6.7	8.2	..	..	..
Oil	Exports	4.3	12.3	8.0	9.0	..	..	..
	Imports	45.3	61.8	71.0	77.0	..	..	..
	Bunkers	1.4	3.7	5.7	6.0	..	..	..
	Net Imports	39.6	45.9	57.3	62.0	..	..	..
Gas	Exports	–	–	–	–	..	..	..
	Imports	0.9	3.7	11.5	12.1	..	..	..
	Net Imports	0.9	3.7	11.5	12.1	..	..	..
Electricity	Exports	0.2	0.3	0.7	0.5	..	..	..
	Imports	0.0	0.3	0.4	0.8	..	..	..
	Net Imports	–0.2	–0.0	–0.3	0.3	..	..	..
TOTAL STOCK CHANGES		**–1.5**	**–0.1**	**0.8**	**–1.8**	**..**	**–**	**..**
TOTAL SUPPLY (TPES)		**52.4**	**90.6**	**107.6**	**112.8**	**..**	**134.5**	**..**
Coal[1]		9.0	19.4	18.3	17.3	..	9.9	..
Oil		38.4	46.5	57.1	61.5	..	67.3	..
Gas		0.9	5.0	11.3	11.6	..	23.9	..
Comb. Renewables & Wastes[2]		0.0	3.4	3.7	3.7	..	11.0	..
Nuclear		1.7	14.1	14.4	15.4	..	16.4	..
Hydro		2.5	2.2	3.0	2.9	..	3.4	..
Geothermal		–	–	0.0	0.0	..	0.0	..
Solar/Wind/Other[3]		–	0.0	0.1	0.1	..	2.4	..
Electricity Trade[5]		–0.2	–0.0	–0.3	0.3	..	0.2	..
Shares (%)								
Coal		*17.2*	*21.5*	*17.0*	*15.3*	..	*7.4*	..
Oil		*73.3*	*51.3*	*53.1*	*54.5*	..	*50.0*	..
Gas		*1.8*	*5.5*	*10.5*	*10.3*	..	*17.8*	..
Comb. Renewables & Wastes		–	*3.7*	*3.4*	*3.2*	..	*8.2*	..
Nuclear		*3.3*	*15.6*	*13.4*	*13.6*	..	*12.2*	..
Hydro		*4.7*	*2.4*	*2.8*	*2.6*	..	*2.6*	..
Geothermal		–	–	–	–	..	–	..
Solar/Wind/Other		–	–	*0.1*	*0.1*	..	*1.8*	..
Electricity Trade		*–0.3*	–	*–0.2*	*0.3*	..	*0.1*	..

0 is negligible, – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**39.9**	**61.4**	**75.8**	**80.5**	**..**	**97.8**	**..**
Coal[1]	4.0	3.2	1.7	1.5	..	2.2	..
Oil	30.1	39.9	49.3	52.8	..	58.1	..
Gas	0.7	4.6	8.3	9.2	..	13.3	..
Comb. Renewables & Wastes[2]	–	2.8	2.6	2.6	..	4.9	..
Geothermal	–	–	0.0	0.0	..	0.0	..
Solar/Wind/Other	–	–	0.0	0.0	..	0.3	..
Electricity	5.1	10.8	13.7	14.2	..	19.0	..
Heat	–	0.0	0.1	0.1	..	..	..
Shares (%)							
Coal	*9.9*	*5.3*	*2.3*	*1.9*	..	*2.3*	..
Oil	*75.6*	*65.0*	*65.1*	*65.6*	..	*59.4*	..
Gas	*1.8*	*7.5*	*10.9*	*11.5*	..	*13.6*	..
Comb. Renewables & Wastes	–	*4.5*	*3.5*	*3.3*	..	*5.0*	..
Geothermal	–	–	–	–	..	–	..
Solar/Wind/Other	–	–	–	–	..	*0.3*	..
Electricity	*12.7*	*17.6*	*18.0*	*17.6*	..	*19.4*	..
Heat	–	–	*0.1*	*0.1*	..	..	..
TOTAL INDUSTRY[6]	**20.7**	**24.4**	**28.9**	**30.6**	**..**	**37.5**	**..**
Coal[1]	3.6	2.9	1.5	1.3	..	2.1	..
Oil	13.4	11.3	14.0	15.1	..	14.5	..
Gas	0.4	3.8	6.6	7.2	..	9.9	..
Comb. Renewables & Wastes[2]	–	0.9	0.8	0.8	..	2.3	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	0.0	0.0	..	..	..
Electricity	3.3	5.4	5.9	6.1	..	8.7	..
Heat	–	–	0.1	0.1	..	..	..
Shares (%)							
Coal	*17.5*	*12.1*	*5.3*	*4.3*	..	*5.7*	..
Oil	*64.7*	*46.4*	*48.3*	*49.2*	..	*38.6*	..
Gas	*2.0*	*15.5*	*22.8*	*23.6*	..	*26.5*	..
Comb. Renewables & Wastes	–	*3.7*	*2.8*	*2.7*	..	*6.1*	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*15.8*	*22.3*	*20.5*	*20.0*	..	*23.1*	..
Heat	–	–	*0.2*	*0.2*	..	..	..
TRANSPORT[7]	**11.9**	**22.8**	**28.6**	**31.2**	**..**	**35.6**	**..**
TOTAL OTHER SECTORS[8]	**7.2**	**14.2**	**18.3**	**18.7**	**..**	**24.6**	**..**
Coal[1]	0.3	0.3	0.2	0.2	..	0.1	..
Oil	4.9	6.1	7.1	6.9	..	8.9	..
Gas	0.3	0.8	1.7	2.0	..	3.3	..
Comb. Renewables & Wastes[2]	–	1.9	1.8	1.8	..	2.1	..
Geothermal	–	–	0.0	0.0	..	0.0	..
Solar/Wind/Other	–	–	0.0	0.0	..	0.3	..
Electricity	1.7	5.1	7.4	7.7	..	9.9	..
Heat	–	0.0	–	–	..	..	..
Shares (%)							
Coal	*4.3*	*2.1*	*1.2*	*1.1*	..	*0.4*	..
Oil	*68.2*	*43.0*	*38.7*	*36.9*	..	*36.0*	..
Gas	*4.1*	*5.9*	*9.2*	*10.7*	..	*13.6*	..
Comb. Renewables & Wastes	–	*13.3*	*10.0*	*9.8*	..	*8.5*	..
Geothermal	–	–	–	–	..	–	..
Solar/Wind/Other	–	–	*0.1*	*0.1*	..	*1.4*	..
Electricity	*23.4*	*35.7*	*40.7*	*41.4*	..	*40.2*	..
Heat	–	–	–	–	..	..	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**12.6**	**33.4**	**38.7**	**38.9**	**..**	**..**	**..**
OUTPUT (Mtoe)	**6.5**	**13.0**	**16.3**	**16.6**	**..**	**22.2**	**..**
(TWh gross)	*75.7*	151.2	189.3	193.5	..	257.9	..
Output Shares (%)							
Coal	*18.9*	*40.1*	*33.8*	*32.6*	..	*11.0*	..
Oil	*33.2*	*5.7*	*7.5*	*9.0*	..	*8.0*	..
Gas	*1.0*	*1.0*	*9.6*	*8.4*	..	*27.0*	..
Comb. Renewables & Wastes	*0.1*	*0.5*	*1.2*	*1.2*	..	*6.4*	..
Nuclear	*8.7*	*35.9*	*29.2*	*30.5*	..	*24.4*	..
Hydro	*38.2*	*16.8*	*18.4*	*17.6*	..	*14.7*	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	*0.0*	*0.4*	*0.7*	..	*8.6*	..
TOTAL LOSSES	**12.5**	**28.9**	**31.2**	**31.4**	**..**	**..**	**..**
of which:							
Electricity and Heat Generation[10]	6.1	20.4	22.3	22.2	..	..	..
Other Transformation	2.7	2.3	1.7	1.7	..	..	..
Own Use and Losses[11]	3.7	6.1	7.1	7.5	..	..	..
Statistical Differences	**0.0**	**0.3**	**0.6**	**0.8**	**..**	**–**	**..**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	315.49	491.94	557.57	578.74	684.66	771.99	..
Population (millions)	34.81	38.85	39.32	39.37	39.60	39.80	..
TPES/GDP[12]	0.17	0.18	0.19	0.19	..	0.17	..
Energy Production/TPES	0.22	0.38	0.29	0.28	..	–	..
Per Capita TPES[13]	1.50	2.33	2.74	2.86	..	3.38	..
Oil Supply/GDP[12]	0.12	0.09	0.10	0.11	..	0.09	..
TFC/GDP[12]	0.13	0.12	0.14	0.14	..	0.13	..
Per Capita TFC[13]	1.15	1.58	1.93	2.04	..	2.46	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	147.1	215.0	254.0	261.5	..	311.8	..
CO_2 Emissions from Bunkers (Mt CO_2)	4.3	11.6	18.2	19.2	..	..	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	4.1	2.8	2.5	4.8	..	..	..
Coal	3.0	5.5	–0.9	–5.2	..	..	..
Oil	4.1	–0.5	3.0	7.6	..	..	..
Gas	6.7	12.3	12.5	2.7	..	..	..
Comb. Renewables & Wastes	24.8	47.0	1.1	0.0	..	..	..
Nuclear	0.4	20.9	0.3	6.7	..	..	..
Hydro	8.2	–5.3	4.6	–2.2	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	71.7	62.5	..	..	..
TFC	4.1	1.7	3.1	6.2	..	..	..
Electricity Consumption	6.4	3.6	3.4	3.9	..	..	..
Energy Production	5.5	7.3	–1.1	1.5	..	..	..
Net Oil Imports	3.2	–0.4	3.2	8.3	..	..	..
GDP	2.3	2.8	1.8	3.8	2.4	2.4	..
Growth in the TPES/GDP Ratio	1.8	–0.0	0.7	1.0	..	..	..
Growth in the TFC/GDP Ratio	1.8	–1.1	1.2	2.3	..	..	..

Please note: Rounding may cause totals to differ from the sum of the elements.

SWITZERLAND

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**4.28**	**9.72**	**10.99**	**11.16**	**10.29**	**10.28**	**..**
Coal[1]		–	–	–	–	–	–	..
Oil		..	–	–	–	–	–	..
Gas		–	0.00	–	–	–	–	..
Comb. Renewables & Wastes[2]		0.24	0.98	1.41	1.51	1.45	1.49	..
Nuclear		1.64	6.18	6.64	6.75	5.84	5.76	..
Hydro		2.40	2.56	2.93	2.88	2.97	2.99	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	–	0.02	0.02	0.03	0.04	..
TOTAL NET IMPORTS[4]		**15.23**	**15.16**	**15.02**	**15.58**	**14.34**	**14.37**	**..**
Coal[1]	Exports	0.02	0.01	–	–	–	–	..
	Imports	0.24	0.35	0.07	0.06	0.04	0.02	..
	Net Imports	0.22	0.34	0.07	0.06	0.04	0.02	..
Oil	Exports	0.23	0.16	0.51	0.47	..	..	..
	Imports	15.38	13.54	13.74	14.14	12.03	11.79	..
	Bunkers	–	0.02	0.01	0.01	..	..	..
	Net Imports	15.16	13.36	13.22	13.66	12.03	11.79	..
Gas	Exports	–	–	–	–	–	–	..
	Imports	0.15	1.63	2.29	2.36	2.52	2.64	..
	Net Imports	0.15	1.63	2.29	2.36	2.52	2.64	..
Electricity	Exports	0.90	1.97	2.37	2.54	1.70	1.50	..
	Imports	0.60	1.79	1.78	2.03	1.45	1.42	..
	Net Imports	–0.30	–0.18	–0.58	–0.51	–0.25	–0.08	..
TOTAL STOCK CHANGES		**0.22**	**0.12**	**0.21**	**–0.14**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**19.72**	**25.00**	**26.22**	**26.61**	**24.63**	**24.65**	**..**
Coal[1]		0.33	0.36	0.11	0.09	0.04	0.02	..
Oil		15.26	13.46	13.39	13.50	12.03	11.79	..
Gas		0.15	1.63	2.29	2.36	2.52	2.64	..
Comb. Renewables & Wastes[2]		0.24	0.99	1.41	1.52	1.45	1.49	..
Nuclear		1.64	6.18	6.64	6.75	5.84	5.76	..
Hydro		2.40	2.56	2.93	2.88	2.97	2.99	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	–	0.02	0.02	0.03	0.04	..
Electricity Trade[5]		–0.30	–0.18	–0.58	–0.51	–0.25	–0.08	..
Shares (%)								
Coal		*1.7*	*1.4*	*0.4*	*0.3*	*0.2*	*0.1*	..
Oil		*77.4*	*53.8*	*51.1*	*50.7*	*48.8*	*47.8*	..
Gas		*0.8*	*6.5*	*8.7*	*8.9*	*10.2*	*10.7*	..
Comb. Renewables & Wastes		*1.2*	*4.0*	*5.4*	*5.7*	*5.9*	*6.0*	..
Nuclear		*8.3*	*24.7*	*25.3*	*25.4*	*23.7*	*23.4*	..
Hydro		*12.2*	*10.2*	*11.2*	*10.8*	*12.1*	*12.1*	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other		–	–	*0.1*	*0.1*	*0.1*	*0.2*	..
Electricity Trade		*–1.5*	*–0.7*	*–2.2*	*–1.9*	*–1.0*	*–0.3*	..

0 is negligible, – is nil, .. is not available.

Please note: Forecast data are based on 1998 submission and data for electricity and heat generation are IEA Secretariat estimates.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**17.57**	**19.59**	**20.23**	**20.95**	**19.75**	**19.83**	**..**
Coal[1]	0.29	0.35	0.11	0.09	0.04	0.02	..
Oil	14.30	12.85	12.74	13.27	11.54	11.31	..
Gas	0.24	1.52	2.10	2.17	2.30	2.40	..
Comb. Renewables & Wastes[2]	0.24	0.60	0.73	0.79	1.05	1.07	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	0.02	0.02	0.02	0.02	..
Electricity	2.50	4.04	4.20	4.27	4.52	4.71	..
Heat	–	0.25	0.34	0.35	0.28	0.30	..
Shares (%)							
Coal	*1.6*	*1.8*	*0.5*	*0.4*	*0.2*	*0.1*	..
Oil	*81.4*	*65.6*	*63.0*	*63.4*	*58.4*	*57.0*	..
Gas	*1.3*	*7.7*	*10.4*	*10.3*	*11.6*	*12.1*	..
Comb. Renewables & Wastes	*1.4*	*3.0*	*3.6*	*3.7*	*5.3*	*5.4*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	*0.1*	*0.1*	*0.1*	*0.1*	..
Electricity	*14.2*	*20.6*	*20.7*	*20.4*	*22.9*	*23.8*	..
Heat	–	*1.3*	*1.7*	*1.7*	*1.4*	*1.5*	..
TOTAL INDUSTRY[6]	**4.78**	**3.93**	**4.11**	**4.17**	**4.49**	**4.57**	**..**
Coal[1]	0.08	0.33	0.10	0.08	0.03	0.02	..
Oil	3.70	1.31	1.29	1.28	1.41	1.34	..
Gas	0.05	0.59	0.91	0.93	1.00	1.03	..
Comb. Renewables & Wastes[2]	–	0.16	0.34	0.36	0.50	0.52	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	0.95	1.48	1.40	1.43	1.50	1.61	..
Heat	–	0.05	0.08	0.08	0.05	0.05	..
Shares (%)							
Coal	*1.6*	*8.4*	*2.4*	*1.9*	*0.7*	*0.4*	..
Oil	*77.4*	*33.4*	*31.4*	*30.8*	*31.4*	*29.3*	..
Gas	*1.1*	*15.1*	*22.1*	*22.3*	*22.3*	*22.5*	..
Comb. Renewables & Wastes	–	*4.1*	*8.3*	*8.6*	*11.1*	*11.4*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*19.9*	*37.7*	*33.9*	*34.4*	*33.4*	*35.2*	..
Heat	–	*1.2*	*1.8*	*1.9*	*1.1*	*1.1*	..
TRANSPORT[7]	**4.29**	**6.29**	**6.73**	**6.85**	**6.32**	**6.49**	**..**
TOTAL OTHER SECTORS[8]	**8.49**	**9.38**	**9.39**	**9.93**	**8.94**	**8.77**	**..**
Coal[1]	0.21	0.02	0.01	0.01	0.01	–	..
Oil	6.48	5.47	4.93	5.36	4.11	3.81	..
Gas	0.19	0.92	1.19	1.24	1.30	1.37	..
Comb. Renewables & Wastes[2]	0.24	0.44	0.39	0.43	0.55	0.55	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	0.02	0.02	0.02	0.02	..
Electricity	1.37	2.34	2.59	2.62	2.72	2.77	..
Heat	–	0.20	0.26	0.27	0.23	0.25	..
Shares (%)							
Coal	*2.5*	*0.2*	*0.1*	*0.1*	*0.1*	–	..
Oil	*76.3*	*58.3*	*52.5*	*53.9*	*46.0*	*43.4*	..
Gas	*2.2*	*9.8*	*12.6*	*12.4*	*14.5*	*15.6*	..
Comb. Renewables & Wastes	*2.8*	*4.7*	*4.1*	*4.3*	*6.2*	*6.3*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	*0.2*	*0.2*	*0.2*	*0.2*	..
Electricity	*16.1*	*24.9*	*27.6*	*26.4*	*30.4*	*31.6*	..
Heat	–	*2.2*	*2.8*	*2.7*	*2.6*	*2.9*	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**4.48**	**9.35**	**10.47**	**10.66**	**9.59**	**9.60**	**..**
OUTPUT (Mtoe)	**3.17**	**4.70**	**5.30**	**5.31**	**5.09**	**5.11**	**..**
(TWh gross)	36.82	54.62	61.62	61.71	59.19	59.42	..
Output Shares (%)							
Coal	*–*	*0.1*	*–*	*–*	*–*	*–*	..
Oil	*7.1*	*0.5*	*0.3*	*0.6*	*1.0*	*1.1*	..
Gas	*–*	*0.6*	*1.4*	*1.4*	*1.7*	*1.9*	..
Comb. Renewables & Wastes	*–*	*1.0*	*1.8*	*1.9*	*1.0*	*1.1*	..
Nuclear	*17.1*	*43.3*	*41.2*	*41.9*	*37.8*	*37.1*	..
Hydro	*75.8*	*54.6*	*55.3*	*54.2*	*58.4*	*58.5*	..
Geothermal	*–*	*–*	*–*	*–*	*–*	*–*	..
Solar/Wind/Other	*–*	*–*	*0.0*	*0.0*	*0.2*	*0.3*	..
TOTAL LOSSES	**2.17**	**5.05**	**5.61**	**5.78**	**4.88**	**4.82**	**..**
of which:							
Electricity and Heat Generation[10]	1.32	4.38	4.81	4.97	4.20	4.17	..
Other Transformation	0.14	0.01	–0.02	–0.04	0.07	0.04	..
Own Use and Losses[11]	0.72	0.66	0.83	0.84	0.61	0.61	..
Statistical Differences	**–0.02**	**0.36**	**0.37**	**–0.12**	**–**	**–**	**..**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	182.31	228.41	232.10	236.86	255.72	264.79	..
Population (millions)	6.44	6.71	7.09	7.11	7.39	7.44	..
TPES/GDP[12]	0.11	0.11	0.11	0.11	0.10	0.09	..
Energy Production/TPES	0.22	0.39	0.42	0.42	0.42	0.42	..
Per Capita TPES[13]	3.06	3.72	3.70	3.74	3.33	3.31	..
Oil Supply/GDP[12]	0.08	0.06	0.06	0.06	0.05	0.04	..
TFC/GDP[12]	0.10	0.09	0.09	0.09	0.08	0.07	..
Per Capita TFC[13]	2.73	2.92	2.85	2.95	2.67	2.67	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	45.9	44.2	44.8	45.1	41.0	40.5	..
CO_2 Emissions from Bunkers (Mt CO_2)	–	0.1	0.0	0.0	..	..	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	0.2	2.1	0.7	1.5	–1.1	0.0	..
Coal	–6.3	4.5	–15.5	–17.3	–11.1	–12.9	..
Oil	–2.2	0.1	–0.1	0.8	–1.6	–0.4	..
Gas	31.0	7.2	5.0	2.9	0.9	0.9	..
Comb. Renewables & Wastes	11.2	7.3	5.2	7.2	–0.6	0.5	..
Nuclear	11.0	6.5	1.0	1.7	–2.1	–0.3	..
Hydro	2.1	–0.5	1.9	–1.7	0.4	0.1	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	10.5	5.2	5.9	..
TFC	–0.6	1.3	0.5	3.5	–0.8	0.1	..
Electricity Consumption	2.6	3.0	0.5	1.7	0.8	0.8	..
Energy Production	6.5	4.1	1.8	1.5	–1.2	–0.0	..
Net Oil Imports	–1.6	–0.3	–0.2	3.3	–1.8	–0.4	..
GDP	–0.4	2.3	0.2	2.1	1.1	0.7	..
Growth in the TPES/GDP Ratio	0.6	–0.2	0.5	–0.6	–2.2	–0.7	..
Growth in the TFC/GDP Ratio	–0.3	–0.9	0.2	1.4	–1.9	–0.6	..

Please note: Rounding may cause totals to differ from the sum of the elements.

TURKEY

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**15.48**	**25.68**	**27.56**	**28.65**	**34.50**	**46.39**	**56.72**
Coal[1]		5.21	12.41	13.12	13.95	20.77	26.84	30.84
Oil		3.59	3.79	3.53	3.29	1.52	0.96	0.65
Gas		–	0.18	0.21	0.47	0.17	0.14	0.11
Comb. Renewables & Wastes[2]		6.45	7.21	7.02	6.99	5.33	4.42	4.00
Nuclear		–	–	–	–	–	3.66	7.32
Hydro		0.22	1.99	3.42	3.63	4.58	6.10	7.62
Geothermal		–	0.09	0.18	0.23	1.91	3.83	5.56
Solar/Wind/Other[3]		–	0.02	0.08	0.10	0.23	0.44	0.63
TOTAL NET IMPORTS[4]		**8.74**	**27.64**	**43.18**	**43.91**	**95.50**	**123.93**	**169.46**
Coal[1]	Exports	–	–	–	–	–	–	–
	Imports	0.01	4.21	7.51	7.85	15.13	28.65	54.29
	Net Imports	0.01	4.21	7.51	7.85	15.13	28.65	54.29
Oil	Exports	0.86	1.90	1.31	2.12	..	..	..
	Imports	9.68	22.83	28.78	29.62	37.99	45.23	53.93
	Bunkers	0.09	0.12	0.16	0.16	..	..	..
	Net Imports	8.73	20.81	27.31	27.34	37.99	45.23	53.93
Gas	Exports	–	–	–	–	–	–	–
	Imports	–	2.68	8.17	8.46	42.04	50.06	61.25
	Net Imports	–	2.68	8.17	8.46	42.04	50.06	61.25
Electricity	Exports	–	0.08	0.02	0.03	..	..	..
	Imports	–	0.02	0.21	0.28	0.34	..	..
	Net Imports	–	–0.06	0.19	0.26	0.34	..	..
TOTAL STOCK CHANGES		**0.11**	**–0.82**	**0.54**	**–0.04**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**24.32**	**52.50**	**71.27**	**72.51**	**130.00**	**170.32**	**226.18**
Coal[1]		5.15	16.94	21.18	21.99	35.90	55.49	85.12
Oil		12.50	23.46	30.86	30.37	39.51	46.19	54.57
Gas		–	2.86	8.34	8.94	42.21	50.19	61.36
Comb. Renewables & Wastes[2]		6.45	7.21	7.02	6.99	5.33	4.42	4.00
Nuclear		–	–	–	–	–	3.66	7.32
Hydro		0.22	1.99	3.42	3.63	4.58	6.10	7.62
Geothermal		–	0.09	0.18	0.23	1.91	3.83	5.56
Solar/Wind/Other[3]		–	0.02	0.08	0.10	0.23	0.44	0.63
Electricity Trade[5]		–	–0.06	0.19	0.26	0.34	–	–
Shares (%)								
Coal		*21.2*	*32.3*	*29.7*	*30.3*	*27.6*	*32.6*	*37.6*
Oil		*51.4*	*44.7*	*43.3*	*41.9*	*30.4*	*27.1*	*24.1*
Gas		–	*5.4*	*11.7*	*12.3*	*32.5*	*29.5*	*27.1*
Comb. Renewables & Wastes		*26.5*	*13.7*	*9.9*	*9.6*	*4.1*	*2.6*	*1.8*
Nuclear		–	–	–	–	–	*2.1*	*3.2*
Hydro		*0.9*	*3.8*	*4.8*	*5.0*	*3.5*	*3.6*	*3.4*
Geothermal		–	*0.2*	*0.3*	*0.3*	*1.5*	*2.2*	*2.5*
Solar/Wind/Other		–	–	*0.1*	*0.1*	*0.2*	*0.3*	*0.3*
Electricity Trade		–	*–0.1*	*0.3*	*0.4*	*0.3*	–	–

0 is negligible, – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**19.99**	**40.20**	**53.62**	**53.74**	**91.22**	**120.81**	**161.29**
Coal[1]	2.94	7.57	9.01	9.05	19.59	30.16	50.63
Oil	9.70	20.80	26.65	26.05	36.11	42.56	50.46
Gas	0.04	0.72	4.07	4.11	14.20	17.76	19.83
Comb. Renewables & Wastes[2]	6.45	7.21	6.85	6.90	5.33	4.42	4.00
Geothermal	–	0.02	0.11	0.15	1.83	3.75	5.49
Solar/Wind/Other	–	0.02	0.08	0.10	0.23	0.44	0.63
Electricity	0.85	3.87	6.85	7.38	13.94	21.72	30.26
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*14.7*	*18.8*	*16.8*	*16.8*	*21.5*	*25.0*	*31.4*
Oil	*48.5*	*51.7*	*49.7*	*48.5*	*39.6*	*35.2*	*31.3*
Gas	*0.2*	*1.8*	*7.6*	*7.7*	*15.6*	*14.7*	*12.3*
Comb. Renewables & Wastes	*32.3*	*17.9*	*12.8*	*12.8*	*5.8*	*3.7*	*2.5*
Geothermal	–	–	*0.2*	*0.3*	*2.0*	*3.1*	*3.4*
Solar/Wind/Other	–	*0.1*	*0.1*	*0.2*	*0.2*	*0.4*	*0.4*
Electricity	*4.3*	*9.6*	*12.8*	*13.7*	*15.3*	*18.0*	*18.8*
Heat	–	–	–	–	–	–	–
TOTAL INDUSTRY[6]	**4.30**	**13.71**	**20.25**	**21.45**	**41.19**	**59.50**	**88.19**
Coal[1]	1.14	4.52	6.38	7.06	14.63	23.60	41.96
Oil	2.60	6.16	8.10	8.65	10.32	12.30	15.47
Gas	0.00	0.67	2.20	1.92	8.18	10.12	11.28
Comb. Renewables & Wastes[2]	–	–	–	–	–	–	–
Geothermal	–	–	–	–	0.41	0.65	0.99
Solar/Wind/Other	–	0.01	0.02	0.02	0.15	0.26	0.39
Electricity	0.55	2.35	3.55	3.80	7.52	12.57	18.10
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*26.5*	*33.0*	*31.5*	*32.9*	*35.5*	*39.7*	*47.6*
Oil	*60.5*	*44.9*	*40.0*	*40.3*	*25.1*	*20.7*	*17.5*
Gas	*0.1*	*4.9*	*10.9*	*8.9*	*19.8*	*17.0*	*12.8*
Comb. Renewables & Wastes	–	–	–	–	–	–	–
Geothermal	–	–	–	–	*1.0*	*1.1*	*1.1*
Solar/Wind/Other	–	*0.1*	*0.1*	*0.1*	*0.4*	*0.4*	*0.4*
Electricity	*12.9*	*17.2*	*17.5*	*17.7*	*18.3*	*21.1*	*20.5*
Heat	–	–	–	–	–	–	–
TRANSPORT[7]	**4.49**	**9.58**	**12.19**	**11.37**	**18.80**	**22.71**	**26.70**
TOTAL OTHER SECTORS[8]	**11.21**	**16.91**	**21.17**	**20.92**	**31.23**	**38.60**	**46.41**
Coal[1]	1.28	3.03	2.62	1.99	4.96	6.56	8.67
Oil	3.15	5.11	6.42	6.10	7.15	7.79	8.61
Gas	0.04	0.05	1.84	2.16	6.02	7.62	8.54
Comb. Renewables & Wastes[2]	6.45	7.21	6.85	6.90	5.33	4.42	4.00
Geothermal	–	0.02	0.11	0.15	1.42	3.10	4.49
Solar/Wind/Other	–	0.01	0.06	0.08	0.08	0.18	0.24
Electricity	0.29	1.49	3.28	3.55	6.28	8.94	11.86
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	11.4	17.9	12.4	9.5	15.9	17.0	18.7
Oil	*28.1*	*30.2*	*30.3*	*29.2*	*22.9*	*20.2*	*18.6*
Gas	*0.3*	*0.3*	*8.7*	*10.3*	*19.3*	*19.7*	*18.4*
Comb. Renewables & Wastes	*57.5*	*42.6*	*32.4*	*33.0*	*17.0*	*11.4*	*8.6*
Geothermal	–	*0.1*	*0.5*	*0.7*	*4.6*	*8.0*	*9.7*
Solar/Wind/Other	–	*0.1*	*0.3*	*0.4*	*0.3*	*0.5*	*0.5*
Electricity	*2.6*	*8.8*	*15.5*	*16.9*	*20.1*	*23.2*	*25.6*
Heat	–	–	–	–	–	–	–

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**2.77**	**11.08**	**19.31**	**20.93**	**47.51**	**65.88**	**89.01**
OUTPUT (Mtoe)	**1.07**	**4.95**	**8.88**	**9.55**	**16.84**	**25.78**	**35.40**
(TWh gross)	12.43	*57.54*	103.30	111.02	195.86	299.72	411.62
Output Shares (%)							
Coal	*26.1*	*35.1*	*32.8*	*32.1*	*31.9*	*35.3*	*35.1*
Oil	*51.4*	*6.9*	*6.9*	*7.1*	*0.9*	*0.3*	*0.2*
Gas	*–*	*17.7*	*21.4*	*22.4*	*39.9*	*35.9*	*36.2*
Comb. Renewables & Wastes	*1.6*	*–*	*0.3*	*0.2*	*..*	*..*	*..*
Nuclear	*–*	*–*	*–*	*–*	*–*	*4.7*	*6.8*
Hydro	*20.9*	*40.2*	*38.5*	*38.0*	*27.2*	*23.7*	*21.5*
Geothermal	*–*	*0.1*	*0.1*	*0.1*	*0.0*	*0.0*	*0.0*
Solar/Wind/Other	*–*	*–*	*–*	*0.0*	*0.0*	*0.0*	*0.0*
TOTAL LOSSES	**4.03**	**11.18**	**16.87**	**18.34**	**38.78**	**49.51**	**64.89**
of which:							
Electricity and Heat Generation[10]	1.70	6.13	10.42	11.39	30.67	40.11	53.61
Other Transformation	1.32	2.49	2.15	2.43	2.90	3.06	3.53
Own Use and Losses[11]	1.00	2.56	4.30	4.53	5.21	6.34	7.74
Statistical Differences	**0.30**	**1.13**	**0.79**	**0.43**	**–**	**–**	**–**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	71.29	150.68	203.05	208.71	270.97	345.84	456.30
Population (millions)	38.45	56.20	63.75	64.79	69.83	74.12	77.86
TPES/GDP[12]	0.34	0.35	0.35	0.35	0.48	0.49	0.50
Energy Production/TPES	0.64	0.49	0.39	0.40	0.27	0.27	0.25
Per Capita TPES[13]	0.63	0.93	1.12	1.12	1.86	2.30	2.90
Oil Supply/GDP[12]	0.18	0.16	0.15	0.15	0.15	0.13	0.12
TFC/GDP[12]	0.28	0.27	0.26	0.26	0.34	0.35	0.35
Per Capita TFC[13]	0.52	0.72	0.84	0.83	1.31	1.63	2.07
Energy–related CO_2 Emissions (Mt CO_2)[14]	56.9	138.4	187.5	189.0	345.2	458.8	622.0
CO_2 Emissions from Bunkers (Mt CO_2)	0.3	0.4	0.5	0.5	..	..	..

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	3.7	5.1	4.5	1.7	8.7	5.6	5.8
Coal	4.1	9.0	3.2	3.9	7.3	9.1	8.9
Oil	3.1	4.1	4.0	–1.6	3.8	3.2	3.4
Gas	–	–	16.5	7.2	24.8	3.5	4.1
Comb. Renewables & Wastes	3.1	–0.7	–0.4	–0.5	–3.8	–3.7	–2.0
Nuclear	–	–	–	–	–	–	14.9
Hydro	25.7	7.6	8.1	6.1	3.4	5.9	4.5
Geothermal	–	–	11.2	26.3	35.6	15.0	7.7
Solar/Wind/Other	–	–	21.1	25.0	12.5	14.1	7.4
TFC	4.1	4.2	4.2	0.2	7.9	5.8	6.0
Electricity Consumption	11.3	8.2	8.5	7.6	9.5	9.3	6.9
Energy Production	1.9	3.6	1.0	4.0	2.7	6.1	4.1
Net Oil Imports	5.1	5.3	4.0	0.1	4.8	3.6	3.6
GDP	4.5	4.5	4.4	2.8	3.8	5.0	5.7
Growth in the TPES/GDP Ratio	–0.8	0.6	0.1	–1.0	4.7	0.5	0.1
Growth in the TFC/GDP Ratio	–0.4	–0.3	–0.1	–2.5	3.9	0.7	0.2

Please note: Rounding may cause totals to differ from the sum of the elements.

A

ANNEX

ENERGY BALANCES
AND
KEY STATISTICAL DATA TABLES

Table A1

GDP Growth Rates for IEA Countries[1]

(annual average percentage change)

	1973-79	1994	1995	1996	1997	1998	1999
Canada	3.9	3.9	2.1	1.2	3.7	3.0	3.7
United States	2.6	3.7	2.9	4.2	5.3	3.9	4.1
North America	**2.7**	**3.7**	**2.8**	**3.9**	**5.1**	**3.8**	**4.1**
Australia	2.8	5.3	4.1	3.7	2.8	5.1	3.9
Japan	3.5	0.6	1.5	5.0	1.4	–2.8	1.4
New Zealand	0.7	5.4	3.8	2.6	2.0	–0.8	2.7
Pacific	**3.4**	**1.1**	**1.7**	**4.9**	**1.6**	**–2.0**	**1.7**
Austria	3.0	2.5	1.5	2.0	2.5	3.3	2.2
Belgium	2.4	2.6	2.3	1.3	3.0	2.9	1.8
Czech Republic	2.5	3.2	6.4	3.9	1.0	–2.7	–0.5
Denmark	1.9	5.8	3.2	3.2	3.3	2.9	1.3
Finland	2.1	4.5	5.1	3.6	6.0	4.7	3.7
France	2.7	2.7	2.2	1.4	2.3	3.2	2.4
Germany	2.4	2.7	1.2	1.3	2.2	2.8	1.5
Greece	3.7	2.0	2.1	2.5	3.3	3.5	3.3
Hungary	4.3	2.9	1.5	1.3	4.6	5.1	3.8
Ireland	4.9	8.1	11.8	8.3	10.6	10.4	8.6
Italy	3.5	2.2	2.9	0.7	1.5	1.4	1.0
Luxembourg	1.3	0.3	7.8	3.0	3.7	5.7	5.1
Netherlands	2.6	3.2	2.3	3.1	3.6	3.8	3.0
Norway	4.8	5.5	3.8	5.5	3.4	2.1	0.6
Portugal	2.9	2.2	2.9	3.2	3.7	3.9	3.1
Spain	2.3	2.3	2.7	2.4	3.5	3.8	3.7
Sweden	1.8	3.3	3.9	1.3	1.8	2.9	3.9
Switzerland	–0.4	0.5	0.5	0.3	1.7	2.1	1.4
Turkey	4.5	–5.5	7.2	7.0	7.5	2.8	–2.3
United Kingdom	1.5	4.3	2.8	2.3	3.4	2.1	1.7
IEA Europe	**2.5**	**2.7**	**2.5**	**1.9**	**2.8**	**2.8**	**1.9**
IEA Total	**2.7**	**2.8**	**2.5**	**3.2**	**3.4**	**2.2**	**2.7**

1. Data are in 1990 dollars at 1990 prices

Sources: *National Accounts, Volume 1*, OECD Paris, 1999, and *Main Economic Indicators*, OECD Paris, May 2000.

Table A2

TPES/GDP Ratios for IEA Countries[1]

	1973	1979	1997	1998	1999[2]	Average Annual Growth Rates (%) 1987-92	1993-98
Canada	0.47	0.45	0.37	0.35	0.35	–0.3	–1.5
United States	0.47	0.44	0.32	0.31	0.31	–0.8	–2.4
North America	**0.47**	**0.44**	**0.33**	**0.31**	**0.31**	**–0.7**	**–2.3**
Australia	0.32	0.32	0.29	0.27	0.27	0.2	–1.6
Japan	0.20	0.18	0.15	0.15	0.15	–0.2	0.9
New Zealand	0.24	0.25	0.33	0.33	0.33	4.6	0.08
Pacific	**0.22**	**0.20**	**0.17**	**0.17**	**0.17**	**–0.2**	**0.7**
Austria	0.21	0.19	0.16	0.15	0.15	–2.2	–0.4
Belgium	0.34	0.31	0.26	0.26	0.26	–0.9	0.4
Czech Republic	2.23	2.07	1.56	1.55	1.44	–1.6	–2.6
Denmark	0.20	0.19	0.13	0.13	0.12	–1.9	–2.5
Finland	0.26	0.26	0.23	0.22	0.21	–1.6	–1.7
France	0.22	0.20	0.19	0.19	0.19	0.0	–1.1
Germany	0.30	0.28	0.19	0.18	0.18	–4.2	–1.6
Greece	0.22	0.23	0.27	0.28	0.27	1.5	0.8
Hungary	0.89	0.92	0.76	0.71	0.69	–0.8	–3.2
Ireland	0.31	0.29	0.17	0.16	0.16	–3.5	–5.1
Italy	0.19	0.17	0.14	0.14	0.14	–0.2	–0.2
Luxembourg	0.73	0.58	0.23	0.21	0.21	–1.9	–6.9
Netherlands	0.32	0.31	0.22	0.21	0.20	–1.9	–2.0
Norway	0.23	0.22	0.16	0.16	0.17	–1.0	–2.6
Portugal	0.18	0.21	0.25	0.26	0.27	2.2	1.3
Spain	0.17	0.18	0.19	0.19	0.20	1.8	0.9
Sweden	0.24	0.24	0.21	0.21	0.20	–1.4	–0.5
Switzerland	0.11	0.11	0.11	0.11	0.11	–0.4	0.2
Turkey	0.34	0.33	0.35	0.35	0.35	–0.1	0.8
United Kingdom	0.32	0.29	0.21	0.21	0.20	–0.2	–1.8
IEA Europe	**0.26**	**0.25**	**0.20**	**0.20**	**0.19**	**–1.5**	**–1.0**
IEA Total	**0.33**	**0.31**	**0.24**	**0.24**	**0.23**	**–1.1**	**–1.2**

1. Measured in toe per $1 000 of GDP at 1990 prices and exchange rates; changes in energy intensity reflect the combined effects of efficiency improvements, structural changes, fuel substitution and exchange rates.
2. Preliminary data.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, *National Accounts, Volume 1*, OECD Paris, 1999, and *Main Economic Indicators*, OECD Paris, May 2000.

Table A3

TPES per Inhabitant for IEA Countries

(toe per capita)

	1973	1979	1997	1998	1999[1]	Average Annual Growth Rates (%) 1987-92	1993-98
Canada	7.14	7.86	7.98	7.73	7.92	–0.4	0.3
United States	8.19	8.36	8.17	8.11	8.25	0.2	0.7
North America	**8.09**	**8.31**	**8.16**	**8.07**	**8.21**	**0.1**	**0.7**
Australia	4.27	4.73	5.65	5.60	5.73	0.8	1.3
Japan	2.98	3.06	4.10	4.03	4.07	3.6	1.8
New Zealand	2.78	2.89	4.62	4.53	4.60	3.7	0.9
Pacific	**3.11**	**3.24**	**4.31**	**4.24**	**4.30**	**3.2**	**1.7**
Austria	2.87	3.16	3.56	3.57	3.60	0.3	1.7
Belgium	4.76	4.92	5.61	5.72	5.73	1.7	2.6
Czech Republic	4.58	4.73	4.13	3.99	3.68	–3.5	–0.3
Denmark	3.94	4.15	4.00	3.92	3.79	–1.0	0.6
Finland	4.57	5.12	6.43	6.49	6.49	–2.2	2.6
France	3.39	3.54	4.22	4.34	4.36	1.9	0.8
Germany	4.28	4.73	4.23	4.20	4.13	–2.0	0.2
Greece	1.38	1.68	2.44	2.57	2.60	3.3	3.3
Hungary	2.06	2.68	2.50	2.50	2.50	–4.0	0.1
Ireland	2.34	2.63	3.42	3.58	3.77	1.6	3.4
Italy	2.35	2.50	2.87	2.95	2.97	1.9	1.4
Luxembourg	12.83	10.69	8.08	7.79	8.21	3.2	–4.3
Netherlands	4.65	4.91	4.80	4.74	4.67	0.5	0.7
Norway	3.82	4.62	5.55	5.75	5.85	0.3	0.9
Portugal	0.84	1.03	2.03	2.19	2.33	7.0	4.3
Spain	1.50	1.80	2.74	2.86	3.01	5.0	3.7
Sweden	4.83	5.30	5.81	5.93	5.74	–1.4	1.8
Switzerland	3.06	3.15	3.70	3.74	3.70	0.8	0.8
Turkey	0.63	0.70	1.12	1.12	1.09	1.3	2.8
United Kingdom	3.93	3.91	3.85	3.93	3.89	0.5	0.7
IEA Europe	**3.09**	**3.27**	**3.43**	**3.48**	**3.46**	**0.2**	**1.0**
IEA Total	**4.61**	**4.81**	**5.11**	**5.10**	**5.15**	**0.6**	**1.0**

1. Preliminary data.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, *National Accounts, Volume 1*, OECD Paris, 1999, and *Main Economic Indicators*, OECD Paris, May 2000.

Table A4

TFC/GDP Ratios for IEA Countries[1]

	1973	1979	1996	1997	1998	Average Annual Growth Rates (%) 1987-92	1993-98
Canada	0.39	0.36	0.29	0.29	0.27	–0.2	–0.9
United States	0.34	0.30	0.22	0.21	0.20	–1.0	–2.5
North America	**0.34**	**0.31**	**0.23**	**0.22**	**0.21**	**–0.9**	**–2.4**
Australia	0.22	0.22	0.19	0.19	0.18	0.3	–1.4
Japan	0.15	0.13	0.10	0.10	0.10	–0.6	0.6
New Zealand	0.18	0.19	0.24	0.23	0.24	3.4	0.4
Pacific	**0.16**	**0.14**	**0.11**	**0.11**	**0.11**	**–0.5**	**0.5**
Austria	0.16	0.15	0.13	0.13	0.13	–1.7	–0.7
Belgium	0.25	0.23	0.19	0.19	0.18	–0.8	0.7
Czech Republic	1.63	1.66	0.97	0.94	0.95	–4.9	–4.5
Denmark	0.16	0.15	0.10	0.10	0.09	0.1	–2.6
Finland	0.23	0.21	0.17	0.17	0.17	0.9	–2.4
France	0.17	0.15	0.13	0.12	0.12	0.2	–0.8
Germany	0.22	0.20	0.14	0.13	0.13	–4.6	–1.6
Greece	0.16	0.17	0.19	0.19	0.20	0.2	1.8
Hungary	0.71	0.73	0.55	0.51	0.49	–2.3	–2.8
Ireland	0.23	0.23	0.13	0.13	0.12	–4.0	–4.9
Italy	0.14	0.13	0.11	0.11	0.11	–0.3	–0.3
Luxembourg	0.48	0.44	0.22	0.21	0.21	–1.4	–4.2
Netherlands	0.25	0.24	0.18	0.17	0.17	–2.1	–1.9
Norway	0.21	0.19	0.13	0.13	0.13	–2.7	–1.8
Portugal	0.15	0.17	0.19	0.20	0.20	0.6	1.9
Spain	0.13	0.14	0.13	0.14	0.14	2.0	1.6
Sweden	0.21	0.20	0.15	0.15	0.14	–0.9	–1.5
Switzerland	0.10	0.09	0.09	0.09	0.09	–0.1	0.0
Turkey	0.28	0.27	0.27	0.26	0.26	–1.0	–0.2
United Kingdom	0.21	0.19	0.15	0.14	0.14	–0.1	–2.0
IEA Europe	**0.20**	**0.18**	**0.14**	**0.14**	**0.14**	**–1.7**	**–1.0**
IEA Total	**0.24**	**0.22**	**0.17**	**0.16**	**0.16**	**–1.3**	**–1.3**

1. Measured in toe per $1 000 of GDP at 1990 prices and exchange rates.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, *National Accounts, Volume 1*, OECD Paris, 1999, and *Main Economic Indicators*, OECD Paris, May 2000.

Table A5

Total Energy Demand in IEA Countries

(Mtoe and %)

	1973						1979					
	TPES	Shares of TPES					TPES	Shares of TPES				
	Mtoe	Coal %	Oil %	Natural Gas %	Nuclear %	Other[1] %	Mtoe	Coal %	Oil %	Natural Gas %	Nuclear %	Other[1] %
Canada	161.0	9.5	50.3	23.2	2.5	14.5	190.8	10.4	48.2	22.9	5.1	13.4
United States	**1736.4**	**17.9**	**47.5**	**29.6**	**1.3**	**3.7**	**1881.2**	**19.5**	**47.0**	**25.4**	**3.7**	**4.4**
North America	1897.4	17.2	47.7	29.1	1.4	4.6	2072.0	18.7	47.1	25.1	3.9	5.2
Australia	57.6	39.2	47.1	5.9	–	7.8	68.7	36.0	46.8	10.1	–	7.1
Japan	323.6	17.9	77.9	1.6	0.8	1.8	354.6	14.4	73.0	5.2	5.2	2.2
New Zealand	8.3	15.3	53.5	3.4	–	27.8	9.1	10.6	46.7	9.3	–	33.4
Pacific	**389.5**	**21.0**	**72.8**	**2.2**	**0.6**	**3.3**	**432.4**	**17.8**	**68.3**	**6.1**	**4.2**	**3.6**
Austria	21.8	18.3	56.4	15.3	–	10.1	23.9	15.2	53.6	18.3	–	12.9
Belgium	46.3	24.1	60.5	15.4	0.0	–0.1	48.4	21.7	52.9	19.2	6.1	–0.0
Czech Republic	45.4	78.4	19.6	2.2	–	–0.2	48.7	71.9	23.5	4.6	–	0.0
Denmark	19.8	9.7	88.7	–	–	1.6	21.2	20.4	76.1	n.a.	–	3.5
Finland	21.3	12.0	63.6	–	–	24.4	24.4	17.4	54.0	3.3	7.2	18.0
France	176.6	16.6	70.4	7.7	2.2	3.2	189.8	17.1	61.8	11.0	5.5	4.7
Germany	337.9	41.2	47.9	8.5	0.9	1.4	369.6	37.4	43.6	13.9	3.7	1.4
Greece	12.4	17.0	77.7	–	–	5.2	16.0	21.6	73.6	n.a.	–	4.8
Hungary	21.5	36.8	38.2	19.4	–	5.5	28.7	29.7	39.8	25.8	–	4.8
Ireland	7.2	22.0	77.1	–	–	0.8	8.9	22.5	71.5	5.2	–	0.8
Italy	128.6	6.3	77.9	11.1	0.6	4.1	140.7	7.4	71.0	16.1	0.5	5.0
Luxembourg	4.5	54.1	37.1	4.9	–	4.0	3.9	47.4	33.8	12.1	–	6.6
Netherlands	62.4	4.6	49.5	45.6	0.5	–0.2	69.0	4.8	46.0	47.6	1.3	0.4
Norway	15.1	6.0	55.5	–	–	38.5	18.8	5.3	49.5	3.8	–	41.4
Portugal	7.2	7.0	75.4	–	–	17.5	10.0	4.4	78.3	–	–	17.3
Spain	52.4	17.2	73.3	1.8	3.3	4.4	66.8	16.1	73.3	2.1	2.6	5.9
Sweden	39.3	4.1	72.2	–	1.4	22.3	43.9	4.1	62.3	–	12.5	21.2
Switzerland	19.7	1.7	77.4	0.8	8.3	11.9	20.0	1.1	66.9	3.8	15.4	12.8
Turkey	24.3	21.2	51.4	–	–	27.4	30.3	21.6	49.6	–	–	28.8
United Kingdom	220.8	34.6	50.5	11.4	3.3	0.2	220.0	33.7	43.2	18.4	4.5	0.2
IEA Europe	**1284.5**	**26.7**	**57.8**	**9.9**	**1.5**	**4.1**	**1402.9**	**25.1**	**52.5**	**14.0**	**3.6**	**4.8**
IEA Total	**3571.4**	**21.0**	**54.1**	**19.3**	**1.4**	**4.3**	**3907.3**	**20.9**	**51.4**	**19.0**	**3.8**	**4.9**

1. Includes hydro, geothermal, combustible renewables, wastes, solar, wind, tide, wave, ambient heat used in heat pumps, and electricity and heat trade.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

Table A5 (continued)

Total Energy Demand in IEA Countries
(Mtoe and %)

	1998						1999[1]						1998-99
	TPES	Shares of TPES					TPES	Shares of TPES					Change in TPES
	Mtoe	Coal %	Oil %	Natural Gas %	Nuclear %	Other[2] %	Mtoe	Coal %	Oil %	Natural Gas %	Nuclear %	Other[2] %	%
Canada	234.3	12.4	35.0	29.2	8.0	15.5	242.6	11.9	35.0	28.9	7.9	16.4	3.5
United States	2181.8	23.6	39.8	22.7	8.5	5.4	2238.9	23.2	38.9	23.3	9.0	5.6	2.6
North America	**2416.1**	**22.5**	**39.4**	**23.4**	**8.5**	**6.3**	**2481.5**	**22.1**	**38.6**	**23.9**	**8.9**	**6.6**	**2.7**
Australia	105.0	43.1	33.6	16.9	–	6.4	108.4	43.2	34.1	16.4	–	6.3	3.2
Japan	510.1	16.6	51.1	11.7	17.0	3.6	516.8	17.0	51.1	12.0	16.4	3.5	1.3
New Zealand	17.2	7.0	38.4	24.2	–	30.3	17.6	6.3	37.1	27.3	–	29.2	2.5
Pacific	**632.3**	**20.7**	**47.9**	**12.9**	**13.7**	**4.8**	**642.8**	**21.1**	**47.9**	**13.2**	**13.2**	**4.6**	**1.7**
Austria	28.8	11.2	43.4	23.3	–	22.2	29.1	10.4	42.7	23.6	–	23.3	1.0
Belgium	58.3	14.7	42.1	21.4	20.6	1.2	58.3	12.8	41.5	22.6	21.9	1.1	–0.0
Czech Republic	41.0	51.4	20.3	18.7	8.4	1.2	37.8	47.1	22.0	20.5	9.2	1.2	–7.8
Denmark	20.8	27.0	46.0	20.3	–	6.7	20.1	23.8	46.0	22.0	–	8.2	–3.3
Finland	33.5	16.4	32.1	10.0	17.0	24.6	33.5	15.6	31.6	10.0	17.9	24.9	0.1
France	255.7	6.6	36.2	13.1	39.5	4.7	257.7	6.0	36.0	13.4	39.9	4.8	0.8
Germany	344.5	24.3	40.6	21.1	12.2	1.7	337.2	23.5	40.1	21.3	13.1	1.9	–2.1
Greece	27.0	33.1	58.5	2.7	–	5.7	27.4	32.3	57.8	4.4	–	5.5	1.6
Hungary	25.3	16.5	28.8	38.7	14.4	1.6	25.2	16.7	27.5	39.3	14.6	1.9	–0.3
Ireland	13.3	22.1	54.8	21.1	–	1.9	14.1	18.5	58.3	21.3	–	2.0	6.4
Italy	167.9	7.0	55.7	30.4	–	6.8	169.2	7.0	53.1	32.8	–	7.2	0.8
Luxembourg	3.3	3.4	62.1	19.1	–	15.4	3.5	3.2	62.7	18.6	–	15.5	6.2
Netherlands	74.4	11.8	37.0	47.0	1.3	2.9	73.5	10.0	38.3	46.4	1.4	3.9	–1.2
Norway	25.4	4.2	33.6	16.9	–	45.3	26.0	4.0	33.4	18.2	–	44.4	2.3
Portugal	21.8	14.2	71.9	3.2	–	10.7	23.3	16.3	67.7	8.3	–	7.6	6.6
Spain	112.8	15.3	54.5	10.3	13.6	6.2	118.6	16.5	53.9	11.2	12.9	5.4	5.2
Sweden	52.5	5.1	30.8	1.4	36.5	26.2	50.9	5.0	31.3	1.4	35.9	26.4	–3.0
Switzerland	26.6	0.3	50.7	8.9	25.4	14.7	26.4	0.3	50.1	9.3	24.7	15.7	–0.7
Turkey	72.5	30.3	41.9	12.3	–	15.4	71.3	28.7	42.3	14.9	–	14.1	–1.7
United Kingdom	232.9	17.5	35.8	34.1	11.2	1.5	231.1	16.4	34.8	36.4	10.9	1.6	–0.7
IEA Europe	**1638.3**	**16.4**	**41.5**	**21.3**	**14.4**	**6.4**	**1634.4**	**15.5**	**41.1**	**22.3**	**14.6**	**6.4**	**–0.2**
IEA Total	**4686.7**	**20.1**	**41.3**	**21.2**	**11.3**	**6.1**	**4758.6**	**19.7**	**40.7**	**21.9**	**11.4**	**6.3**	**1.5**

1. Preliminary data.
2. Includes hydro, geothermal, combustible renewables, wastes, solar, wind, tide, wave, ambient heat used in heat pumps, and electricity and heat trade.
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

Table A5 (continued)

Total Energy Demand in IEA Countries
(Mtoe and %)

	2005						2010						2005-10
	TPES	Shares of TPES					TPES	Shares of TPES					Change in TPES
	Mtoe	Coal %	Oil %	Natural Gas %	Nuclear %	Other[1] %	Mtoe	Solid Fuels %	Oil %	Natural Gas %	Nuclear %	Other[1] %	%
Canada	270.7	9.9	33.5	31.5	8.6	16.6	282.2	9.2	34.1	32.8	7.2	16.7	4.2
United States	2453.2	24.4	39.6	23.2	7.6	5.2	2595.1	23.4	40.0	24.7	6.7	5.2	5.8
North America	**2723.9**	**22.9**	**39.0**	**24.0**	**7.7**	**6.4**	**2877.3**	**22.1**	**39.4**	**25.5**	**6.7**	**6.3**	**5.6**
Australia	119.6	37.0	33.6	23.4	–	6.0	127.7	34.7	33.7	25.8	–	5.9	6.8
Japan	..	..	..	..	..	..	539.9	14.6	43.8	12.4	23.2	6.1	..
New Zealand	18.3	10.3	34.2	17.0	–	38.5	20.6	9.7	38.1	14.4	–	37.7	12.8
Pacific	**..**	**..**	**..**	**..**	**..**	**..**	**688.2**	**18.2**	**41.7**	**14.9**	**18.2**	**7.0**	**..**
Austria	30.8	6.8	36.2	32.3	–	24.6	32.8	5.6	34.2	34.9	–	25.3	6.7
Belgium	54.4	14.2	40.1	22.8	22.6	0.3	57.3	13.4	39.3	24.7	21.4	1.1	5.4
Czech Republic	39.2	35.7	18.1	27.6	17.1	1.5	41.1	34.8	18.5	27.5	16.3	2.9	4.8
Denmark	20.9	21.5	44.1	26.0	–	8.5	21.8	25.1	43.6	24.6	–	6.7	3.9
Finland	34.7	21.6	26.8	15.0	15.0	21.6	35.2	21.3	26.4	15.9	14.8	21.6	1.4
France	..	..	..	..	..	..	307.8	3.5	36.5	19.4	36.2	4.4	..
Germany	350.9	21.7	40.1	22.2	12.6	3.4	350.4	21.1	39.9	24.0	11.2	3.7	–0.1
Greece	36.5	24.9	62.4	8.1	–	4.5	44.5	25.6	62.9	7.9	–	3.7	21.9
Hungary	27.4	11.1	26.8	43.0	13.7	5.4	27.8	10.3	27.3	43.4	13.5	5.5	1.5
Ireland	15.4	17.1	51.4	28.6	–	2.8	17.3	13.5	52.4	31.0	–	3.0	11.9
Italy	173.9	6.8	51.0	35.5	–	6.8	185.8	6.7	46.4	38.8	–	8.2	6.8
Luxembourg	3.8	2.6	51.4	37.3	–	8.6	3.7	2.7	48.4	39.5	–	9.5	–1.9
Netherlands	86.7	8.6	37.4	50.2	0.4	3.5	92.2	7.9	37.7	51.0	–	3.4	6.3
Norway	..	..	..	..	..	..	..	..	..	..	..	..	..
Portugal	23.1	15.5	58.5	15.8	–	10.2	25.2	14.4	53.0	22.7	–	10.0	9.1
Spain	..	..	..	..	..	..	134.5	7.4	50.0	17.8	12.2	12.6	..
Sweden	52.6	4.9	33.3	1.9	33.0	26.9	53.7	4.7	30.5	1.8	34.0	29.0	2.0
Switzerland	24.6	0.2	48.8	10.2	23.7	17.1	24.7	0.1	47.8	10.7	23.4	18.0	0.1
Turkey	130.0	27.6	30.4	32.5	–	9.5	170.3	32.6	27.1	29.5	2.1	8.7	31.0
United Kingdom	245.3	14.6	38.6	37.5	8.0	1.3	249.4	11.0	39.5	42.3	5.9	1.3	1.7
IEA Europe	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**
IEA Total	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**

1. Includes hydro, geothermal, combustible renewables, wastes, solar, wind, tide, wave, ambient heat used in heat pumps, and electricity and heat trade.

Note: The IEA Secretariat has estimated data for certain countries. Please see Energy Balances and Key Statistical Data for details.

Source: Country submissions.

Table A6

Development of IEA Energy Self–Sufficiency by Product

(Mtoe and %)

	1973			1979			1997			1998			1999[1]		
	TPES	Production	%	TPES	Production	%	TPES	Production	%	TPES	Production	%	TPES	Production	%
North America															
Coal	326.3	345.1	105.7	386.8	443.6	114.7	557.0	604.2	108.5	543.0	611.1	112.5	547.7	591.5	108.0
Oil	905.0	630.2	69.6	975.6	581.7	59.6	936.8	518.9	55.4	951.0	510.1	53.6	956.8	487.8	51.0
Natural Gas	551.8	564.0	102.2	520.6	521.8	100.2	579.2	580.1	100.1	564.3	582.0	103.1	592.0	583.3	98.5
Total	**1897.4**	**1653.5**	**87.1**	**2072.0**	**1736.1**	**83.8**	**2420.4**	**2050.7**	**84.7**	**2416.1**	**2061.1**	**85.3**	**2481.5**	**2047.6**	**82.5**
Pacific															
Coal	81.7	59.4	72.7	76.9	62.3	81.1	133.1	145.1	109.0	131.0	151.8	115.8	135.9	156.0	114.7
Oil	283.7	20.8	7.3	295.1	23.7	8.0	314.2	31.9	10.1	302.6	34.1	11.3	307.7	28.7	9.3
Natural Gas	8.7	6.0	68.1	26.4	9.9	37.6	78.9	32.3	40.9	81.5	32.8	40.2	84.6	33.4	39.5
Total	**389.5**	**101.5**	**26.1**	**432.4**	**129.9**	**30.1**	**639.8**	**322.7**	**50.4**	**632.3**	**335.8**	**53.1**	**642.8**	**332.7**	**51.8**
IEA Europe															
Coal	342.8	303.3	88.5	352.8	296.6	84.1	273.4	170.9	62.5	268.2	156.2	58.3	253.6	149.7	59.0
Oil	742.6	22.9	3.1	736.9	118.9	16.1	665.2	329.4	49.5	680.7	326.2	47.9	672.1	333.1	49.6
Natural Gas	127.0	119.9	94.4	196.0	167.2	85.3	334.4	226.8	67.8	348.5	226.4	65.0	364.3	232.6	63.9
Total	**1284.5**	**517.7**	**40.3**	**1402.9**	**699.1**	**49.8**	**1611.1**	**1063.9**	**66.0**	**1638.3**	**1048.3**	**64.0**	**1634.4**	**1058.4**	**64.8**
IEA Total															
Coal	750.8	707.8	94.3	816.5	802.6	98.3	963.5	920.1	95.5	942.2	919.1	97.5	937.2	897.2	95.7
Oil	1931.3	673.9	34.9	2007.7	724.3	36.1	1916.3	880.2	45.9	1934.3	870.4	45.0	1936.6	849.6	43.9
Natural Gas	687.5	689.9	100.3	743.0	698.9	94.1	992.5	839.1	84.6	994.2	841.2	84.6	1040.9	849.3	81.6
Total	**3571.4**	**2272.8**	**63.6**	**3907.3**	**2565.1**	**65.7**	**4671.2**	**3437.4**	**73.6**	**4686.7**	**3445.2**	**73.5**	**4758.6**	**3438.6**	**72.3**

1. Preliminary data.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

Table A7

Indigenous Production/Primary Energy Supply in IEA Countries, 1998

	Total Energy[1]	Coal[1]	Oil[1]	Gas[1]	Electricity[2]
Canada	1.561	1.409	1.526	2.083	1.051
United States	0.777	1.109	0.443	0.887	0.993
North America	**0.853**	**1.125**	**0.536**	**1.031**	**1.000**
Australia	2.019	3.270	0.873	1.499	1.000
Japan	0.216	0.024	0.003	0.034	1.000
New Zealand	0.806	1.585	0.389	1.000	1.000
Pacific	**0.531**	**1.158**	**0.113**	**0.402**	**1.000**
Austria	0.312	0.093	0.080	0.199	1.003
Belgium	0.220	0.022	–	–	0.983
Czech Republic	0.750	1.234	0.051	0.022	1.040
Denmark	0.970	–	1.220	1.601	1.118
Finland	0.407	0.077	0.007	–	0.883
France	0.491	0.222	0.022	0.055	1.128
Germany	0.382	0.765	0.026	0.215	1.001
Greece	0.367	0.910	0.020	0.055	0.966
Hungary	0.469	0.731	0.257	0.303	0.981
Ireland	0.186	0.277	–	0.502	0.997
Italy	0.173	0.002	0.063	0.305	0.862
Luxembourg	0.014	–	–	–	0.064
Netherlands	0.840	–	0.101	1.649	0.885
Norway	8.129	0.205	18.015	9.603	0.970
Portugal	0.106	–	–	–	0.993
Spain	0.283	0.532	0.009	0.009	0.983
Sweden	0.651	0.120	–	–	1.075
Switzerland	0.420	–	–	–	1.107
Turkey	0.395	0.634	0.108	0.052	0.974
United Kingdom	1.178	0.633	1.667	1.023	0.966
IEA Europe	**0.640**	**0.583**	**0.479**	**0.650**	**0.996**
IEA Total	**0.735**	**0.975**	**0.450**	**0.846**	**0.999**

1. Calculated as production divided by primary energy supply.
2. Calculated as the ratio between domestic generation and total apparent consumption, or TFC plus own-use in the energy sector and distribution losses. Includes CHP units.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

Table A8

Recent Energy and Oil Supply Trends for IEA Countries
(Mtoe and %)

	TPES					Oil Supply					Net Oil Imports[1]				
	1997	1998	% Chg.	1999[2]	% Chg.	1997	1998	% Chg.	1999[2]	% Chg.	1997	1998	% Chg.	1999[2]	% Chg.
Canada	239.5	234.3	–2.2	242.6	3.5	82.3	82.1	–0.2	84.9	3.4	–37.2	–42.4	14.0	–31.7	–25.3
United States	2 180.9	2 181.8	0.0	2 238.9	2.6	854.5	868.9	1.7	871.9	0.4	486.9	516.6	6.1	509.3	–1.4
North America	**2420.4**	**2416.1**	**–0.2**	**2481.5**	**2.7**	**936.8**	**951.0**	**1.5**	**956.8**	**0.6**	**449.7**	**474.2**	**5.4**	**477.6**	**0.7**
Australia	104.7	105.0	0.3	108.4	3.2	35.7	35.3	–1.2	37.0	4.9	8.5	5.8	–31.9	11.6	100.2
Japan	517.7	510.1	–1.5	516.8	1.3	272.1	260.8	–4.2	264.1	1.3	280.8	260.7	–7.2	265.9	2.0
New Zealand	17.4	17.2	–1.2	17.6	2.5	6.4	6.6	2.5	6.5	–1.0	3.7	4.4	18.7	4.7	7.2
Pacific	**639.8**	**632.3**	**–1.2**	**642.8**	**1.7**	**314.2**	**302.6**	**–3.7**	**307.7**	**1.7**	**293.0**	**270.9**	**–7.5**	**282.2**	**4.2**
Austria	28.7	28.8	0.3	29.1	1.0	12.1	12.5	3.5	12.4	–0.5	11.0	11.7	6.1	11.4	–2.4
Belgium	57.1	58.3	2.2	58.3	–0.0	24.2	24.6	1.7	24.2	–1.4	29.1	30.6	4.9	27.6	–9.6
Czech Republic	42.5	41.0	–3.5	37.8	–7.8	7.9	8.3	5.0	8.3	0.1	8.0	8.3	4.2	7.9	–4.7
Denmark	21.1	20.8	–1.5	20.1	–3.3	9.6	9.6	–0.1	9.3	–3.1	–0.8	–0.3	–57.5	–4.6	1315.5
Finland	33.1	33.5	1.2	33.5	0.1	10.3	10.7	4.3	10.6	–1.2	10.6	10.9	3.6	10.9	–0.5
France	247.6	255.7	3.3	257.7	0.8	88.0	92.4	5.0	92.7	0.3	89.6	94.4	5.4	92.5	–2.0
Germany	347.3	344.5	–0.8	337.2	–2.1	139.3	140.0	0.5	135.3	–3.3	137.4	141.4	2.9	129.4	–8.5
Greece	25.6	27.0	5.2	27.4	1.6	15.3	15.8	3.0	15.8	0.3	18.4	19.7	7.3	18.1	–8.4
Hungary	25.4	25.3	–0.7	25.2	–0.3	7.0	7.3	4.3	6.9	–4.9	5.3	5.9	11.1	5.0	–14.4
Ireland	12.5	13.3	5.8	14.1	6.4	6.5	7.3	11.1	8.2	13.1	6.8	7.5	11.0	8.5	12.3
Italy	163.3	167.9	2.8	169.2	0.8	93.5	93.6	0.1	89.8	–4.1	89.0	90.9	2.1	87.0	–4.3
Luxembourg	3.4	3.3	–2.5	3.5	6.2	2.0	2.1	4.4	2.2	7.3	2.0	2.1	6.7	2.2	2.9
Netherlands	74.9	74.4	–0.7	73.5	–1.2	27.6	27.5	–0.3	28.2	2.3	36.8	36.9	0.3	36.8	–0.3
Norway	24.4	25.4	4.3	26.0	2.3	8.4	8.5	1.4	8.7	1.8	–151.6	–144.9	–4.4	–144.3	–0.4
Portugal	20.2	21.8	8.4	23.3	6.6	14.0	15.7	12.3	15.8	0.4	14.5	15.9	9.0	16.7	5.3
Spain	107.6	112.8	4.8	118.6	5.2	57.1	61.5	7.6	64.0	4.1	63.0	68.1	8.0	69.8	2.5
Sweden	51.4	52.5	2.0	50.9	–3.0	16.1	16.2	0.6	15.9	–1.4	17.4	18.4	5.7	16.6	–9.7
Switzerland	26.2	26.6	1.5	26.4	–0.7	13.4	13.5	0.8	13.2	–2.1	13.2	13.7	3.3	12.6	–7.6
Turkey	71.3	72.5	1.7	71.3	–1.7	30.9	30.4	–1.6	30.1	–0.8	27.5	27.5	0.1	27.1	–1.6
United Kingdom	227.4	232.9	2.4	231.1	–0.7	82.1	83.3	1.5	80.4	–3.5	–49.6	–51.8	4.5	–63.4	22.3
IEA Europe	**1611.1**	**1638.3**	**1.7**	**1634.4**	**–0.2**	**665.2**	**680.7**	**2.3**	**672.1**	**–1.3**	**377.7**	**406.9**	**7.7**	**367.8**	**–9.6**
IEA Total	**4671.2**	**4686.7**	**0.3**	**4758.6**	**1.5**	**1916.3**	**1934.3**	**0.9**	**1936.6**	**0.1**	**1120.4**	**1152.0**	**2.8**	**1127.6**	**–2.1**

1. Imports minus exports.
2. IEA Preliminary data.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

Table A9

Share of Oil Use by Sector in IEA Countries
(%)

	TFC				Industry[1]				Residential/Commercial[2]				Transport			
	1973	**1979**	**1997**	**1998**	**1973**	**1979**	**1997**	**1998**	**1973**	**1979**	**1997**	**1998**	**1973**	**1979**	**1997**	**1998**
Canada	58.3	53.3	42.7	43.8	40.4	37.3	29.7	30.4	47.4	35.4	18.9	18.7	98.9	95.2	89.0	89.1
United States	56.3	57.7	53.6	54.4	39.7	48.3	38.3	37.8	32.6	25.0	13.7	13.0	95.9	96.9	96.6	97.1
North America	**56.5**	**57.2**	**52.4**	**53.2**	**39.8**	**47.0**	**37.0**	**36.7**	**34.0**	**26.1**	**14.3**	**13.6**	**96.1**	**96.7**	**96.0**	**96.4**
Australia	61.7	59.7	51.9	51.4	43.8	40.6	26.7	26.3	39.7	26.7	13.3	13.1	99.4	99.6	98.1	98.1
Japan	73.2	70.3	63.2	63.1	67.7	62.2	54.3	54.6	68.5	63.6	44.6	43.3	96.9	97.6	98.0	98.0
New Zealand	60.6	55.2	44.4	44.5	43.9	35.1	11.4	10.1	32.8	22.8	13.8	14.1	99.9	99.9	99.1	99.1
Pacific	**71.3**	**68.4**	**60.8**	**60.6**	**64.7**	**59.1**	**48.9**	**48.9**	**63.4**	**57.7**	**40.1**	**38.9**	**97.6**	**98.1**	**98.0**	**98.0**
Austria	59.9	54.6	45.0	46.1	52.4	41.0	26.7	27.4	46.8	43.2	25.3	25.6	93.1	94.7	95.9	95.5
Belgium	60.7	56.9	54.8	54.2	46.8	38.6	37.9	37.2	64.2	58.3	45.2	43.5	98.4	98.6	98.9	98.8
Czech Republic	24.3	24.8	28.5	31.0	27.2	25.9	24.5	28.5	5.4	8.8	5.5	5.9	88.0	88.6	94.0	94.2
Denmark	88.3	81.2	50.9	50.6	84.5	72.0	33.6	33.0	85.4	77.2	26.8	26.3	99.7	99.7	99.5	99.4
Finland	59.2	54.8	35.1	34.8	66.2	54.3	16.4	16.5	42.3	41.1	28.0	27.9	99.3	99.5	98.6	98.6
France	72.0	66.8	52.9	52.6	63.4	59.2	40.8	38.8	68.0	56.1	28.4	29.0	97.7	98.1	98.0	98.1
Germany	56.0	53.2	53.0	53.1	44.3	39.5	36.7	37.3	53.6	47.8	36.8	35.6	93.5	97.1	97.8	97.9
Greece	77.6	77.4	70.7	70.0	68.7	69.4	53.4	49.5	68.6	61.6	52.4	52.0	99.2	99.7	99.8	99.8
Hungary	38.8	41.7	30.3	32.0	29.6	32.7	30.2	31.4	34.9	35.4	9.6	9.0	81.2	90.6	96.8	97.4
Ireland	71.2	64.3	60.4	61.7	86.6	73.8	39.3	38.4	37.7	30.5	44.8	44.7	100.0	100.0	99.9	99.9
Italy	73.0	65.1	51.6	51.0	62.3	52.1	34.7	33.9	73.5	58.5	23.8	23.1	97.1	97.3	97.6	97.6
Luxembourg	52.1	43.8	61.3	63.2	38.6	19.9	12.3	11.3	78.4	67.8	47.9	48.1	99.0	99.2	99.5	99.5
Netherlands	50.5	42.6	39.1	39.2	48.8	46.7	34.5	34.6	34.2	16.8	6.6	6.4	99.0	99.0	99.0	99.0
Norway	55.9	52.6	43.1	42.1	43.2	43.3	32.3	30.0	50.6	37.3	18.8	18.4	98.3	98.3	96.7	96.7
Portugal	75.1	73.7	72.8	72.9	66.9	66.9	66.5	67.3	59.7	52.9	45.5	43.3	98.0	99.0	99.5	99.5
Spain	75.6	78.6	65.1	65.6	64.7	70.0	48.3	49.2	68.2	64.4	38.7	36.9	98.8	99.1	98.9	98.9
Sweden	70.4	62.8	41.4	41.0	53.4	48.1	27.6	26.7	78.7	62.6	23.6	22.7	96.8	96.9	96.8	97.0
Switzerland	81.4	75.3	63.0	63.4	77.4	64.0	31.4	30.8	76.3	70.7	52.5	53.9	95.9	95.8	96.9	96.9
Turkey	48.5	49.5	49.7	48.5	60.5	56.6	40.0	40.3	28.1	23.8	30.3	29.2	88.1	96.3	99.5	99.4
United Kingdom	52.3	48.5	46.7	46.4	51.9	45.6	38.3	37.4	24.7	21.6	10.4	10.1	99.1	99.1	98.7	98.7
IEA Europe	**60.7**	**56.7**	**50.8**	**50.8**	**52.6**	**47.6**	**37.0**	**36.9**	**52.3**	**44.2**	**27.2**	**26.7**	**96.5**	**97.8**	**98.2**	**98.2**
IEA Total	**59.6**	**58.2**	**52.9**	**53.3**	**48.8**	**49.0**	**39.0**	**38.8**	**43.5**	**36.2**	**22.5**	**22.0**	**96.3**	**97.1**	**96.9**	**97.1**

1. Includes non-energy use.
2. Includes public and agricultural use.
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

Table A10

Historical and Projected Oil Production in IEA Countries

(Mtoe)

	1973	1979	1998	1999[1]	2005	2010	2015
Canada	96.3	86.6	125.2	117.5	163.1	170.9	191.7
United States	533.8	495.1	384.9	370.3	330.9	329.2	337.6
North America	**630.2**	**581.7**	**510.1**	**487.8**	**494.1**	**500.2**	**529.4**
Australia	19.8	22.7	30.8	25.7	30.4	29.4	29.3
Japan	0.8	0.6	0.8	0.7	..	0.7	..
New Zealand	0.2	0.4	2.6	2.3	2.2	2.2	2.2
Pacific	**20.8**	**23.7**	**34.1**	**28.7**	**..**	**32.3**	**..**
Austria	2.7	1.8	1.0	1.0	0.7	0.6	..
Belgium	..	–	–	–	–	–	..
Czech Republic	0.0	0.3	0.4	0.4	0.2	0.2	0.2
Denmark	0.1	0.4	11.7	14.7	11.7	5.5	..
Finland	–	–	0.1	0.1	–	–	..
France	2.1	2.1	2.0	1.8	..	–	..
Germany	6.8	4.9	3.6	3.5	2.0	1.6	1.3
Greece	..	–	0.3	0.0	–	–	..
Hungary	2.0	2.5	1.9	2.0	1.5	1.1	0.9
Ireland	..	–	–	–	–	–	–
Italy	1.1	1.8	5.9	4.6	5.8	5.5	..
Luxembourg	..	–	–	–	–	–	..
Netherlands	1.6	1.6	2.8	2.6	1.7	1.1	0.8
Norway	1.6	19.3	153.9	153.4	..	..	..
Portugal	..	–	–	–	–	–	..
Spain	0.7	1.4	0.5	0.3	..	..	..
Sweden	..	0.0	–	–	–	–	..
Switzerland	..	–	–	–	–	–	..
Turkey	3.6	2.9	3.3	3.0	1.5	1.0	0.6
United Kingdom	0.6	80.0	138.9	145.6	150.0	126.0	..
IEA Europe	**22.9**	**118.9**	**326.2**	**333.1**	**..**	**..**	**..**
IEA Total	**673.9**	**724.3**	**870.4**	**849.6**	**..**	**..**	**..**

1. Preliminary data.

Note: The IEA Secretariat has estimated forecast data for certain countries. Please see Energy Balances and Key Statistical Data for details.

Sources: *Energy Balances of OECD Countries*, Paris IEA/OECD, 2000 for 1973, 1979 and 1998; and country submissions for 2005, 2010 and 2015.

Table A11

Historical and Projected Net Oil Imports of IEA Countries[1]

(Mtoe)

	1979	1997	1998	1999[2]	2005	2010	2015
Canada	7.8	–37.2	–42.4	–31.7	–71.9	–73.9	–87.8
United States	423.7	486.9	516.6	509.3	659.4	730.1	792.0
North America	**431.5**	**449.7**	**474.2**	**477.6**	**587.5**	**656.3**	**704.3**
Australia	10.8	8.5	5.8	11.6	10.6	14.5	17.1
Japan	277.0	280.8	260.7	265.9	..	240.5	..
New Zealand	4.2	3.7	4.4	4.7	4.5	6.1	6.8
Pacific	**292.0**	**293.0**	**270.9**	**282.2**	**..**	**261.1**	**..**
Austria	11.4	11.0	11.7	11.4	10.5	10.7	..
Belgium	29.4	29.1	30.6	27.6	25.8	26.5	..
Czech Republic	11.2	8.0	8.3	7.9	7.3	7.6	7.8
Denmark	15.8	–0.8	–0.3	–4.6	–1.0	5.5	..
Finland	15.3	10.6	10.9	10.9	9.7	9.7	..
France	123.4	89.6	94.4	92.5	..	115.0	..
Germany	162.7	137.4	141.4	129.4	140.6	140.2	137.9
Greece	13.3	18.4	19.7	18.1	26.3	31.5	..
Hungary	9.8	5.3	5.9	5.0	5.9	6.5	7.0
Ireland	6.4	6.8	7.5	8.5	8.0	9.1	9.7
Italy	102.6	89.0	90.9	87.0	85.3	83.0	..
Luxembourg	1.4	2.0	2.1	2.2	2.0	1.8	..
Netherlands	41.5	36.8	36.9	36.8	46.3	51.4	56.8
Norway	–9.7	–151.6	–144.9	–144.3	..	..	..
Portugal	9.2	14.5	15.9	16.7	14.6	14.7	..
Spain	49.6	63.0	68.1	69.8	..	..	..
Sweden	29.4	17.4	18.4	16.6	18.7	17.8	..
Switzerland	13.8	13.2	13.7	12.6	12.0	11.8	..
Turkey	11.8	27.5	27.5	27.1	38.0	45.2	53.9
United Kingdom	19.2	–49.6	–51.8	–63.4	–53.3	–25.5	..
IEA Europe	**667.5**	**377.7**	**406.9**	**367.8**	**..**	**..**	**..**
IEA Total	**1390.9**	**1120.4**	**1152.0**	**1127.6**	**..**	**..**	**..**

1. Includes requirements for marine bunkers.
2. Preliminary data.

Note: The IEA Secretariat has estimated data for certain countries. Please see Energy Balances and Key Statistical Data for details.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 for 1979, 1997 and 1998; and country submissions for 2005, 2010 and 2015.

Table A12

Total IEA Electricity Generation by Fuel
(TWh and %)

	1973		1979		1998		1999[1]		2005[2]		2010[3]	
	Output TWh	**Share %**	**Output TWh**	**Share %**	**Output TWh**	**Share %**	**Output TWh**	**Share %**	**Output TWh**	**Share %**	**Output TWh**	**Share %**
Coal	1605.2	37.3	2018.4	38.1	3254.1	38.3	3236.2	37.5	3039.7	41.7	3319.7	33.4
Oil	1093.5	25.4	1023.5	19.3	543.4	6.4	510.1	5.9	299.2	4.1	412.9	4.2
Natural Gas	512.9	11.9	598.5	11.3	1229.7	14.5	1340.8	15.6	1464.0	20.1	2428.6	24.4
Comb. Renewables & Wastes	6.9	0.2	11.8	0.2	141.9	1.7	149.1	1.7	173.1	2.4	253.9	2.6
Nuclear	188.3	4.4	570.3	10.8	2025.1	23.8	2088.0	24.2	1242.1	17.0	2129.3	21.4
Hydro	889.9	20.7	1071.4	20.2	1254.9	14.8	1248.6	14.5	1006.0	13.8	1270.5	12.8
Geothermal	6.4	0.1	8.6	0.2	25.7	0.3	25.0	0.3	24.5	0.3	39.7	0.4
Solar/Wind	0.6	0.0	0.5	0.0	17.4	0.2	20.7	0.2	43.0	0.6	90.2	0.9
Total	**4303.6**	**100.0**	**5302.8**	**100.0**	**8492.3**	**100.0**	**8618.4**	**100.0**	**7291.7**	**100.0**	**9944.8**	**100.0**

1. Preliminary data.
2. Excluding France, Japan, Norway and Spain.
3. Excluding Norway.

Note: The IEA Secretariat has estimated forecast data for certain countries. Please see Energy Balances and Key Statistical Data for details.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000 for 1973, 1979 and 1998; and country submissions for 2005 and 2010.

Table A13

Electricity Generation in IEA Countries, 1998

	Energy Inputs[1] (Mtoe)	Output in TWh	Shares of Fuel in Electricity Generation (%)					
			Coal	Oil	Gas	Nuclear	Hydro	Other[2]
Canada	82.4	575.0	17.4	2.4	4.1	14.4	61.1	0.7
Canada	81.7	561.7	19.1	3.3	4.6	12.7	59.1	1.1
United States	938.9	3803.7	52.7	3.9	14.7	18.8	7.7	2.2
North America	**1020.6**	**4365.4**	**48.4**	**3.8**	**13.4**	**18.0**	**14.3**	**2.1**
Australia	44.8	194.3	80.0	1.1	9.0	–	8.1	1.7
Japan	213.5	1036.2	19.1	16.4	21.1	32.1	8.9	2.4
New Zealand	6.3	37.6	3.9	–	23.2	–	64.9	8.1
Pacific	**264.6**	**1268.1**	**28.0**	**13.6**	**19.3**	**26.2**	**10.5**	**2.5**
Austria	8.1	55.9	9.1	5.6	15.8	–	66.5	3.0
Belgium	19.6	82.1	20.6	3.1	18.3	56.2	0.5	1.3
Czech Republic	19.7	64.6	71.6	1.0	3.2	20.4	2.2	1.7
Denmark	9.5	41.1	57.6	12.1	19.9	–	0.1	10.4
Finland	14.4	70.2	19.3	1.6	12.6	31.1	21.4	13.9
France	120.1	506.9	7.4	2.3	1.0	76.5	12.2	0.6
Germany	134.6	552.4	54.2	1.2	9.8	29.3	3.1	2.4
Greece	10.6	46.2	70.3	17.5	3.7	–	8.0	0.5
Hungary	10.8	37.2	26.0	16.0	20.0	37.5	0.4	0
Ireland	4.6	20.9	40.4	23.2	30.8	–	4.4	1.2
Italy	48.4	253.6	11.0	42.3	27.9	–	16.3	2.5
Luxembourg	0.1	0.4	n.a.	n.a.	55.3	–	31.2	13.6
Netherlands	19.2	91.2	29.9	3.9	57.0	4.2	0.1	4.9
Norway	10.2	116.1	0.2	0.0	0.2	–	99.4	0.3
Portugal	6.6	38.9	31.0	27.5	5.2	–	33.4	3.0
Spain	38.9	193.5	32.6	9.0	8.4	30.5	17.6	1.9
Sweden	30.4	158.2	2.0	2.1	0.3	46.5	47.0	2.2
Switzerland	10.7	61.7	–	0.6	1.4	41.9	54.2	1.9
Turkey	20.9	111.0	32.1	7.1	22.4	–	38.0	0.3
United Kingdom	77.4	356.6	34.5	1.6	32.5	28.1	1.5	1.8
IEA Europe	**614.8**	**2858.7**	**27.5**	**7.2**	**14.0**	**31.7**	**17.4**	**2.2**
IEA Total	**1899.9**	**8492.3**	**38.3**	**6.4**	**14.5**	**23.8**	**14.8**	**2.2**

1. Includes CHP units.
2. Includes combustible renewables, wastes, geothermal, solar, wind, tide and wave.
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000.

Table A14

Electricity Intensity of IEA Countries[1]

	1973	1979	1996	1997	1998	Average Annual Growth Rates (%) 1987-92	1993-98
Canada	0.75	0.77	0.86	0.83	0.80	0.5	–1.6
United States	0.53	0.55	0.57	0.55	0.54	1.6	–1.6
North America	**0.55**	**0.57**	**0.60**	**0.57**	**0.57**	**1.4**	**–1.7**
Australia	0.36	0.43	0.50	0.50	0.51	1.8	–0.6
Japan	0.29	0.30	0.30	0.30	0.31	0.3	1.8
New Zealand	0.54	0.61	0.71	0.71	0.72	2.1	–0.5
Pacific	**0.30**	**0.32**	**0.32**	**0.33**	**0.34**	**0.4**	**1.5**
Austria	0.28	0.29	0.31	0.30	0.29	–0.3	–0.4
Belgium	0.29	0.32	0.37	0.37	0.37	0.6	0.5
Czech Republic	1.92	2.09	2.37	2.32	2.35	0.4	–0.4
Denmark	0.19	0.23	0.25	0.23	0.22	0.6	–2.6
Finland	0.37	0.42	0.54	0.53	0.53	2.4	–1.7
France	0.22	0.26	0.34	0.33	0.33	0.7	–0.3
Germany	0.34	0.36	0.30	0.30	0.29	–3.3	–0.9
Greece	0.27	0.32	0.48	0.49	0.49	1.8	1.4
Hungary	0.92	0.99	1.16	1.12	1.07	0.9	–1.6
Ireland	0.32	0.34	0.28	0.27	0.26	–0.7	–4.1
Italy	0.21	0.22	0.24	0.24	0.25	1.0	0.8
Luxembourg	0.56	0.57	0.37	0.37	0.37	–4.0	0.1
Netherlands	0.27	0.29	0.29	0.30	0.29	0.4	0.1
Norway	1.03	0.97	0.78	0.76	0.78	–0.9	–2.6
Portugal	0.24	0.33	0.46	0.46	0.47	1.6	1.5
Spain	0.23	0.29	0.32	0.33	0.34	0.4	1.7
Sweden	0.47	0.52	0.60	0.59	0.58	–1.5	–1.7
Switzerland	0.18	0.22	0.24	0.24	0.24	–0.4	–0.1
Turkey	0.17	0.25	0.50	0.52	0.55	4.6	5.3
United Kingdom	0.40	0.39	0.34	0.33	0.33	0.4	–1.2
IEA Europe	**0.31**	**0.33**	**0.35**	**0.34**	**0.34**	**–0.6**	**–0.2**
IEA Total	**0.40**	**0.42**	**0.44**	**0.43**	**0.43**	**0.4**	**–0.5**

1. Calculated as production plus net imports divided by GDP and measured in kWh per dollar of GDP at 1990 prices and exchange rates; includes CHP units.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2000, *National Accounts, Volume 1*, OECD Paris, 1999, and *Main Economic Indicators*, OECD Paris, May 2000.

Table A15

Electricity Generation in IEA Countries

(GW net)

	1998 Total Capacity							1998 Under Construction*						
	Coal	Oil	Natural Gas	Nuclear	Hydro	Other	Total	Coal	Oil	Natural Gas	Nuclear	Hydro	Other	Total
Canada	17.71	8.56	4.91	10.62	66.96	1.19	109.95	0	0	0	0	0	0	0
United States[1]	260.73	54.52	257.90	97.07	98.56	16.00	784.78	0	0	0	0	0	0	0
North America	**278.45**	**63.07**	**262.81**	**107.69**	**165.52**	**17.20**	**894.72**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Australia	26.04	1.17	4.68	–	7.49	0.02	39.40	..	..	..	..	..	..	..
Japan[2, 3]	26.20	51.83	54.90	45.08	43.89	0.50	222.39	..	..	..	..	..	..	..
New Zealand	0.30	0.12	2.01	–	5.16	0.55	8.14	–	–	–	–	0.21	–	0.21
Pacific	**52.54**	**53.12**	**61.59**	**45.08**	**56.54**	**1.07**	**269.92**	**..**	**..**	**..**	**..**	**..**	**..**	**..**
Austria	1.75	0.45	3.46	–	11.44	0.35	17.45	–	–	0.33	–	0.01	0.00	0.35
Belgium	3.14	0.90	4.08	5.71	1.40	0.16	15.40	–	–	0.56	–	–	0.01	0.58
Czech Republic	..	..	..	1.76	2.03	..	14.89	..	..	..	..	..	..	..
Denmark	6.84	1.83	2.28	–	0.01	1.59	12.54	–	–	0.49	–	–	0.34	0.83
Finland	5.17	1.40	2.49	2.64	2.88	1.57	16.14	–	–	0.15	–	0.01	0.35	0.52
France	12.58	11.58	0.93	61.68	25.10	0.74	112.59	..	..	..	..	..	..	..
Germany	51.01	9.21	18.00	22.31	8.85	4.24	113.63	..	..	..	..	..	..	..
Greece	4.55	1.98	0.55	–	2.86	0.09	10.02	0.30	0.21	1.04	–	0.44	0.31	2.29
Hungary	1.80	0.46	3.68	1.84	0.05	0.03	7.85	0.07	0.17	0.55	–	–	–	0.79
Ireland[2]	1.26	0.84	1.76	–	0.53	0.07	4.46	0.12	–	0.16	–	–	–	0.28
Italy	10.93	15.39	24.88	–	20.06	1.25	72.51	0.56	0.71	2.40	–	0.73	0.50	4.89
Luxembourg	–	–	0.05	–	1.14	0.02	1.21	–	–	0.35	–	–	–	0.35
Netherlands	4.18	3.76	11.37	0.45	0.04	0.41	20.21	..	..	..	–	0.01	..	..
Norway	0.10	0.01	0.04	–	28.02	0.13	28.29	..	..	..	..	..	..	..
Portugal	1.78	2.50	0.76	–	4.50	0.25	9.78	–	–	1.21	–	0.31	0.08	1.59
Spain	10.98	9.39	4.75	7.30	16.63	0.96	50.02	..	..	..	..	..	..	..
Sweden	0.73	4.35	0.27	10.08	16.26	1.33	33.03	–	–	–	–	–	–	–
Switzerland	–	0.78	0.05	3.13	11.98	0.29	16.24	..	..	..	..	..	..	..
Turkey	6.57	1.93	4.51	–	10.31	0.05	23.35	1.72	–	1.41	–	3.11	–	6.24
United Kingdom	33.83	5.38	16.08	12.60	4.26	0.51	72.65	..	..	..	..	..	..	..
IEA Europe[4]	**33.83**	**5.38**	**16.08**	**12.60**	**4.26**	**0.51**	**72.65**	**..**	**..**	**..**	**..**	**..**	**..**	**..**
IEA Total[4]	**157.18**	**72.12**	**99.97**	**127.74**	**166.32**	**14.04**	**637.37**	**..**	**..**	**..**	**..**	**..**	**..**	**..**

* These figures reflect capacity under construction (as of December 1998) that will come on line by 2005, as reported in the country submissions (fiscal years for Australia, Japan and New Zealand).

Source: Country submissions.

1. Capacity is net summer capacity.
2. Only gross capacity data are available.
3. Does not include autoproducer capacity.
4. Excludes the Czech Republic

Table A15 (continued)

Electricity Generation in IEA Countries
(GW net)

	2005							2010						
	Total Capacity							Total Capacity						
	Coal	Oil	Natural Gas	Nuclear	Hydro	Other	Total	Coal	Oil	Natural Gas	Nuclear	Hydro	Other	Total
Canada	17.90	6.36	23.31	12.07	69.29	1.25	130.18	14.64	6.61	33.88	10.50	72.84	1.25	139.72
United States[1]	252.21	52.22	333.22	93.01	97.57	23.23	851.47	252.27	49.71	405.75	83.75	97.54	27.08	916.11
North America	**270.11**	**58.58**	**356.53**	**105.08**	**166.86**	**24.48**	**981.65**	**266.91**	**56.32**	**439.63**	**94.25**	**170.38**	**28.33**	**1055.83**
Australia	26.04	1.17	4.68	–	7.49	–	39.38	26.04	1.17	4.68	–	7.49	–	39.38
Japan[2, 3]	..	..	..	..	..	..	..	35.75	56.95	60.80	70.00	57.00	4.60	285.10
New Zealand	1.03	0.12	1.28	–	5.37	0.79	8.58	1.03	0.12	1.58	–	5.37	0.97	9.06
Pacific	..	..	..	..	..	..	..	**62.82**	**58.24**	**67.06**	**70.00**	**69.86**	**5.57**	**333.54**
Austria	1.71	0.30	4.33	–	11.66	0.43	18.44	1.71	0.30	5.11	–	11.66	0.47	19.25
Belgium	1.21	0.69	4.48	5.71	1.40	0.16	13.65	1.21	0.25	4.48	5.71	1.40	1.12	14.17
Czech Republic	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Denmark	3.83	1.49	2.69	–	–	3.21	11.22	3.15	1.42	2.53	–	–	4.05	11.16
Finland	5.17	1.40	2.64	2.64	2.89	1.93	16.66	5.17	1.40	2.64	2.64	2.89	1.93	16.66
France	12.40	11.73	1.24	63.11	25.10	0.76	114.33	12.4	11.7	1.2	63.1	25.1	0.9	114.4
Germany	58.05	7.76	23.22	22.40	10.44	4.86	126.72	58.65	6.86	24.14	22.40	10.64	5.94	128.64
Greece	4.85	2.28	1.58	–	3.46	0.39	12.57	5.69	2.74	2.07	–	3.73	0.51	14.74
Hungary	0.88	0.46	4.44	1.89	0.05	0.03	7.74	0.88	0.46	4.79	1.89	0.05	0.03	8.09
Ireland[2]	1.27	0.84	2.75	–	0.54	0.41	5.81	1.14	0.84	3.55	–	0.54	0.58	6.66
Italy	10.25	13.86	27.22	–	20.78	1.77	73.88	8.29	12.40	32.41	–	21.30	3.00	77.40
Luxembourg	–	–	0.40	–	1.14	0.03	1.57	–	–	0.40	–	1.14	0.03	1.57
Netherlands	..	..	..	..	0.05	1.88	..	..	..	..	..	0.05	2.47	..
Norway	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Portugal	1.78	2.19	2.21	–	4.81	0.65	11.63	1.78	1.97	3.73	–	5.01	0.73	13.21
Spain	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sweden	0.73	3.05	0.27	9.46	16.30	1.56	31.37	0.73	3.05	0.27	8.86	16.70	2.16	31.77
Switzerland	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Turkey	10.76	2.18	14.11	–	15.45	0.14	42.65	16.26	2.33	21.11	2.00	21.47	0.14	63.31
United Kingdom	38.40	–	16.70	13.00	4.30	0.70	73.10	38.40	–	16.70	13.00	4.30	0.70	73.10
IEA Europe	..	..	..	..	..	..	..	..	..	..	..	..	..	..
IEA Total	..	..	..	..	..	..	..	..	..	..	..	..	..	..

1. Capacity is net summer capacity.
2. Only gross capacity data are available.
3. Does not include autoproducer capacity.
Source: Country submissions.

Table A16

Percentage Change in Real Energy Prices for End–Users in IEA Countries, 1998–1999

	Total Energy		Oil Products		Electricity		Gas		Coal	
	Industry	Residential/ Commercial	Industry	Residential/ Commercial	Industry	Residential/ Commercial	Industry	Residential/ Commercial	Industry	Residential/ Commercial
Canada	8.8	9.0	7.4	7.7	..	..	..	..	..	..
United States	–2.4	3.3	19.5	7.4	–3.6	–3.2	–4.0	–4.3	–3.4	..
Australia	..	2.1	..	2.6	..	..	..	..	..	..
Japan	–9.3	–0.2	–1.2	–0.5	..	..	..	..	–25.0	..
New Zealand	4.7	0.7	6.9	0.5	0.1	1.1	5.4	1.2	..	..
Austria	1.4	1.3	0.3	2.8	..	..	..	–1.8	..	0.1
Belgium	–1.3	3.2	4.6	7.1	..	..	..	..	–7.4	–0.4
Czech Republic	1.2	7.5	5.6	3.2	–1.1	8.4	–5.2	9.6	3.2	8.1
Denmark	6.9	6.2	9.5	9.2	–1.1	–1.1	..	3.2	..	1.2
Finland	1.0	4.0	11.1	7.7	–3.5	–3.6	–2.4	–4.6	–3.2	..
France	4.2	0.8	9.1	4.5	..	..	–1.4	–8.3	–3.4	–0.3
Germany	6.7	8.1	13.2	13.6	..	..	..	..	..	..
Greece	5.8	–1.7	7.9	–0.3	–1.6	–8.3	..	..	..	..
Hungary	4.5	–1.5	14.3	9.0	4.1	4.8	–1.5	–8.1	..	0.3
Ireland	1.1	–0.4	1.9	0.3	–1.0	–1.6	0.5	–2.3	..	..
Italy	–1.9	–1.3	9.5	2.7	–4.9	–4.8	..	–4.8	–7.2	..
Luxembourg	9.6	5.6	9.6	6.7	..	–0.6	..	..	..	..
Netherlands	–6.5	–1.5	6.5	2.6	1.5	5.6	..	..	..	..
Norway	5.9	–1.8	5.9	2.5	..	–4.8	..	..	..	..
Portugal	–2.8	–3.4	0.3	–2.3	–12.0	–6.9	..	..	–14.3	..
Spain	4.0	0.9	7.1	3.7	–1.6	–5.0	–0.9	–7.9	..	..
Sweden	2.9	1.7	6.5	3.2	..	..	..	..	..	..
Switzerland	2.6	4.4	10.0	6.1	–0.9	–0.5	–5.8	–3.6	–1.8	..
Turkey	3.0	5.3	23.2	13.8	10.6	3.2	–1.0	–6.3	–20.5	–7.1
United Kingdom	4.1	1.8	9.4	6.9	–0.4	–2.7	–3.3	–2.2	–1.5	0.4

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

Table A17

Tax as a Percentage of Oil Product Prices in IEA Countries, 1996–1999

	Heavy Fuel Oil Industry				Heating Oil Residential				Diesel Transport				Premium Unleaded Gasoline (95 RON)[1] Transport			
	1996	1997	1998	1999	1996	1997	1998	1999	1996	1997	1998	1999	1996	1997	1998	1999
Canada	..	..	..	..	..	..	..	..	39.9	38.4	39.4	39.4	48.7	48.0	53.0	49.1
United States	..	..	..	..	..	..	..	..	..	..	..	..	27.1	27.0	30.6	28.2
Australia	..	..	..	..	..	..	..	..	..	..	..	..	57.6	57.8	62.9	60.9
Japan	2.9	4.3	4.8	4.8	2.9	4.3	4.8	4.8	54.1	55.2	54.6	55.6	54.3	55.8	59.9	59.5
New Zealand	..	..	..	..	..	..	..	..	0.8	0.8	0.9	0.9	47.5	45.5	49.4	49.9
Austria	42.9	44.7	48.0	..	38.5	40.5	44.7	42.5	52.2	50.6	55.0	54.6	66.6	64.9	67.8	67.6
Belgium	14.9	14.6	17.5	..	23.7	23.4	25.0	24.1	54.2	53.2	58.2	55.9	72.7	72.6	75.8	73.7
Czech Republic	..	..	..	..	32.3	31.7	32.0	30.5	51.5	45.7	49.6	49.7	61.1	58.0	63.0	62.8
Denmark	..	..	..	..	61.2	59.9	64.2	62.1	43.7	41.9	39.5	36.3	70.7	69.8	72.4	72.3
Finland	..	..	..	..	30.9	35.8	42.0	41.3	54.0	53.2	58.1	54.4	75.1	74.8	78.0	74.3
France	20.4	20.9	26.0	21.5	40.1	39.4	43.4	41.9	64.4	63.9	69.5	67.3	79.6	78.4	81.2	79.1
Germany	..	..	..	..	29.6	29.3	33.3	35.6	58.6	57.5	63.1	61.9	73.7	71.7	75.2	73.8
Greece	..	..	..	..	63.3	61.5	59.8	52.4	57.1	55.3	59.1	57.1	68.0	65.3	66.7	62.9
Hungary	..	..	..	..	..	..	..	..	64.5	64.8	68.7	65.1	65.6	66.2	69.7	66.8
Ireland	7.7	11.5	13.1	9.4	26.6	26.9	27.9	25.7	42.4	46.7	56.7	56.4	64.8	66.7	68.0	67.7
Italy	30.4	31.1	34.6	36.4	70.3	69.4	72.0	71.5	62.1	61.9	65.2	63.7	73.1	72.0	74.7	73.2
Luxembourg	..	..	..	..	13.1	13.0	13.5	13.2	54.2	52.6	56.9	54.2	64.7	62.3	65.5	64.1
Netherlands	20.9	..	..	..	41.8	40.1	45.3	45.9	48.0	56.6	61.1	58.3	72.3	71.9	74.9	73.3
Norway	..	..	..	..	32.7	30.0	31.5	30.0	55.2	61.3	61.0	59.2	72.1	74.3	76.0	74.7
Portugal	19.7	18.7	21.2	18.9	..	..	..	..	58.6	57.4	61.1	59.8	71.3	70.1	72.9	67.7
Spain	8.7	8.6	11.6	9.9	41.5	39.8	44.1	41.5	55.4	53.8	58.0	55.6	67.4	65.0	68.7	66.9
Sweden	..	..	..	..	59.8	60.0	64.7	62.3	48.6	49.4	53.0	49.8	73.7	73.2	75.5	73.1
Switzerland	..	..	..	..	12.4	10.7	11.1	11.4	74.8	73.3	78.3	75.5	69.2	66.4	70.1	69.0
Turkey	41.0	43.8	36.1	28.2	63.2	64.8	63.7	65.4	61.4	63.7	64.0	64.3	65.8	69.0	70.5	71.2
United Kingdom	18.7	21.3	26.9	27.9	21.6	23.0	26.9	26.3	70.3	72.6	78.6	77.5	75.9	77.3	81.5	81.5

1. Regular unleaded gasoline for Australia, Canada and Japan 1996 to 1999.
Regular unleaded gasoline for New Zealand 1996.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2000.

Table A18

Energy Balances and Key Indicators for IEA and Regions

		IEA Total				North America				Pacific				IEA Europe			
		1973	1979	1997	1998	1973	1979	1997	1998	1973	1979	1997	1998	1973	1979	1997	1998
SUPPLY																	**Unit: Mtoe**
TOTAL PRODUCTION		**2272.8**	**2565.1**	**3437.4**	**3445.2**	**1653.5**	**1736.1**	**2050.7**	**2061.1**	**101.5**	**129.9**	**322.7**	**335.8**	**517.7**	**699.1**	**1063.9**	**1048.3**
Coal[1]		707.8	802.6	920.1	919.1	345.1	443.6	604.2	611.1	59.4	62.3	145.1	151.8	303.3	296.6	170.9	156.2
Oil		673.9	724.3	880.2	870.4	630.2	581.7	518.9	510.1	20.8	23.7	31.9	34.1	22.9	118.9	329.4	326.2
Gas		689.9	698.9	839.1	841.2	564.0	521.8	580.1	582.0	6.0	9.9	32.3	32.8	119.9	167.2	226.8	226.4
Comb. Renewables & Wastes[2]		70.3	91.0	76.8	154.6	45.3	59.9	9.8	85.9	3.5	4.0	13.3	13.3	21.5	27.1	53.7	55.4
Nuclear		49.2	149.2	516.0	527.8	27.3	80.3	195.2	204.7	2.5	18.3	83.2	86.6	19.3	50.6	237.6	236.4
Hydro		76.5	92.1	111.1	107.9	39.6	45.3	58.5	53.8	8.0	9.9	11.2	11.4	29.0	37.0	41.4	42.8
Geothermal		5.2	7.0	21.4	22.0	2.1	3.5	12.8	13.2	1.3	1.7	5.7	5.7	1.8	1.8	2.8	3.1
Solar/Wind/Other[3]		0.0	0.1	1.8	2.3	–	–	0.4	0.3	–	0.0	0.1	0.1	0.0	0.0	1.4	1.8
TOTAL NET IMPORTS[4]		**1320.0**	**1398.7**	**1238.4**	**1275.2**	**253.8**	**374.4**	**363.6**	**394.7**	**294.7**	**308.9**	**322.2**	**290.3**	**771.5**	**715.5**	**552.6**	**590.1**
Coal[1]	Exports	84.0	113.5	187.5	194.8	38.7	51.5	77.6	72.3	18.1	26.7	96.2	107.1	27.3	35.2	13.7	15.4
	Imports	114.0	141.7	218.3	224.2	11.2	15.5	16.0	19.6	41.3	41.3	85.0	84.3	61.5	84.9	117.4	120.3
	Net Imports	29.9	28.2	30.8	29.3	–27.5	–36.1	–61.6	–52.7	23.2	14.6	–11.3	–22.8	34.2	49.7	103.7	104.8
Oil	Exports	232.2	252.4	616.9	620.8	74.1	40.4	133.6	136.5	6.3	4.1	26.7	26.6	151.7	207.9	456.5	457.7
	Imports	1582.5	1643.3	1737.3	1772.7	365.3	471.9	583.4	610.7	293.8	296.1	319.7	297.5	923.4	875.4	834.2	864.6
	Bunkers	70.4	73.9	72.1	73.6	9.2	26.0	24.3	24.1	18.9	14.4	6.2	6.5	42.3	33.6	41.6	43.0
	Net Imports	1279.9	1317.0	1048.3	1078.4	281.9	405.5	425.4	450.1	268.7	277.6	286.8	264.4	729.3	633.9	336.1	363.9
Gas	Exports	50.3	82.5	155.4	159.1	24.9	24.0	70.6	76.4	–	–	8.6	8.9	25.5	58.5	76.2	73.9
	Imports	60.0	135.3	313.6	325.2	24.2	29.0	70.5	73.8	2.8	16.7	55.3	57.6	33.0	89.6	187.8	193.8
	Net Imports	9.7	52.8	158.3	166.1	–0.7	5.0	–0.1	–2.6	2.8	16.7	46.7	48.8	7.5	31.2	111.7	119.9
Electricity	Exports	6.7	10.3	22.7	22.5	1.6	2.9	4.7	4.9	–	–	–	–	5.0	7.4	18.0	17.5
	Imports	7.1	10.9	23.2	23.4	1.6	2.9	4.5	4.9	–	–	–	–	5.4	8.1	18.7	18.6
	Net Imports	0.4	0.6	0.5	1.0	0.0	–0.0	–0.1	–0.1	–	–	–	–	0.4	0.7	0.7	1.0
TOTAL STOCK CHANGES		**–21.3**	**–56.6**	**–4.5**	**–33.7**	**–9.8**	**–38.5**	**6.1**	**–39.7**	**–6.7**	**–6.4**	**–5.2**	**6.1**	**–4.8**	**–11.7**	**–5.4**	**–0.1**
TOTAL SUPPLY (TPES)		**3571.4**	**3907.3**	**4671.2**	**4686.7**	**1897.4**	**2072.0**	**2420.4**	**2416.1**	**389.5**	**432.4**	**639.8**	**632.3**	**1284.5**	**1402.9**	**1611.1**	**1638.3**
Coal[1]		750.8	816.5	963.5	942.2	326.3	386.8	557.0	543.0	81.7	76.9	133.1	131.0	342.8	352.8	273.4	268.2
Oil		1931.3	2007.7	1916.3	1934.3	905.0	975.6	936.8	951.0	283.7	295.1	314.2	302.6	742.6	736.9	665.2	680.7
Gas		687.5	743.0	992.5	994.2	551.8	520.6	579.2	564.3	8.7	26.4	78.9	81.5	127.0	196.0	334.4	348.5
Comb. Renewables & Wastes[2]		70.4	91.1	148.1	155.0	45.3	59.9	80.6	85.9	3.5	4.0	13.3	13.3	21.6	27.2	54.1	55.8
Nuclear		49.2	149.2	516.0	527.8	27.3	80.3	195.2	204.7	2.5	18.3	83.2	86.6	19.3	50.6	237.6	236.4
Hydro		76.5	92.1	111.1	107.9	39.6	45.3	58.5	53.8	8.0	9.9	11.2	11.4	29.0	37.0	41.4	42.8
Geothermal		5.2	7.0	21.4	22.0	2.1	3.5	12.8	13.2	1.3	1.7	5.7	5.7	1.8	1.8	2.8	3.1
Solar/Wind/Other[3]		0.0	0.1	1.8	2.3	–	–	0.4	0.3	–	0.0	0.1	0.1	0.0	0.0	1.4	1.8
Electricity Trade[5]		0.4	0.7	0.5	1.0	0.0	–0.0	–0.1	–0.1	–	–	–	–	0.4	0.7	0.7	1.0

Table A18 (continued)

Energy Balances and Key Indicators for IEA and Regions

	IEA Total 1973	IEA Total 1979	IEA Total 1997	IEA Total 1998	North America 1973	North America 1979	North America 1997	North America 1998	Pacific 1973	Pacific 1979	Pacific 1997	Pacific 1998	IEA Europe 1973	IEA Europe 1979	IEA Europe 1997	IEA Europe 1998
SUPPLY																**Unit: Mtoe**
Fuel Shares (%)																
Coal	*21.0*	*20.9*	*20.6*	*20.1*	*17.2*	*18.7*	*23.0*	*22.5*	*21.0*	*17.8*	*20.8*	*20.7*	*26.7*	*25.1*	*17.0*	*16.4*
Oil	*54.1*	*51.4*	*41.0*	*41.3*	*47.7*	*47.1*	*38.7*	*39.4*	*72.8*	*68.3*	*49.1*	*47.9*	*57.8*	*52.5*	*41.3*	*41.5*
Gas	*19.3*	*19.0*	*21.2*	*21.2*	*29.1*	*25.1*	*23.9*	*23.4*	*2.2*	*6.1*	*12.3*	*12.9*	*9.9*	*14.0*	*20.8*	*21.3*
Comb. Renewables & Wastes	*2.0*	*2.3*	*3.2*	*3.3*	*2.4*	*2.9*	*3.3*	*3.6*	*0.9*	*0.9*	*2.1*	*2.1*	*1.7*	*1.9*	*3.4*	*3.4*
Nuclear	*1.4*	*3.8*	*11.0*	*11.3*	*1.4*	*3.9*	*8.1*	*8.5*	*0.6*	*4.2*	*13.0*	*13.7*	*1.5*	*3.6*	*14.8*	*14.4*
Hydro	*2.1*	*2.4*	*2.4*	*2.3*	*2.1*	*2.2*	*2.4*	*2.2*	*2.0*	*2.3*	*1.8*	*1.8*	*2.3*	*2.6*	*2.6*	*2.6*
Geothermal	*0.1*	*0.2*	*0.5*	*0.5*	*0.1*	*0.2*	*0.5*	*0.5*	*0.3*	*0.4*	*0.9*	*0.9*	*0.1*	*0.1*	*0.2*	*0.2*
Solar/Wind/Other	–	–	–	–	–	–	–	–	–	–	–	–	–	–	*0.1*	*0.1*
Electricity Trade	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	*0.1*
DEMAND																**Unit: Mtoe**
FINAL CONSUMPTION BY SECTOR																
TFC	**2627.2**	**2810.2**	**3187.9**	**3194.3**	**1379.1**	**1460.6**	**1623.3**	**1612.2**	**280.4**	**301.6**	**420.2**	**417.9**	**967.6**	**1048.0**	**1144.5**	**1164.2**
Coal[1]	218.2	192.8	114.2	108.2	49.4	45.8	32.1	32.7	26.0	24.2	26.9	24.7	142.9	122.9	55.2	50.8
Oil	1565.6	1635.9	1687.7	1701.8	778.7	835.7	850.6	857.0	199.8	206.2	255.6	253.2	587.1	594.0	581.5	591.6
Gas	475.4	519.3	655.5	635.8	365.0	347.5	384.4	356.8	9.5	14.3	33.6	34.2	100.9	157.5	237.6	244.8
Comb. Renewables & Wastes[2]	47.2	61.4	83.2	87.4	23.6	33.8	35.5	38.6	3.5	3.8	8.5	8.4	20.1	23.8	39.2	40.5
Geothermal	–	–	0.7	0.7	–	–	–	–	–	–	0.6	0.6	–	–	0.1	0.2
Solar/Wind/Other	–	0.0	0.4	0.4	–	–	–	–	–	0.0	0.1	0.1	–	0.0	0.3	0.3
Electricity	313.1	386.7	610.8	624.5	162.3	196.8	312.4	318.9	41.6	53.0	94.5	96.3	109.2	136.9	203.9	209.2
Heat	7.6	14.2	35.4	35.5	0.1	1.0	8.2	8.2	0.0	0.1	0.4	0.5	7.5	13.0	26.8	26.8
Fuel Shares (%)																
Coal	*8.3*	*6.9*	*3.6*	*3.4*	*3.6*	*3.1*	*2.0*	*2.0*	*9.3*	*8.0*	*6.4*	*5.9*	*14.8*	*11.7*	*4.8*	*4.4*
Oil	*59.6*	*58.2*	*52.9*	*53.3*	*56.5*	*57.2*	*52.4*	*53.2*	*71.3*	*68.4*	*60.8*	*60.6*	*60.7*	*56.7*	*50.8*	*50.8*
Gas	*18.1*	*18.5*	*20.6*	*19.9*	*26.5*	*23.8*	*23.7*	*22.1*	*3.4*	*4.7*	*8.0*	*8.2*	*10.4*	*15.0*	*20.8*	*21.0*
Comb. Renewables & Wastes	*1.8*	*2.2*	*2.6*	*2.7*	*1.7*	*2.3*	*2.2*	*2.4*	*1.2*	*1.3*	*2.0*	*2.0*	*2.1*	*2.3*	*3.4*	*3.5*
Geothermal	–	–	–	–	–	–	–	–	–	–	*0.1*	*0.1*	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Electricity	*11.9*	*13.8*	*19.2*	*19.6*	*11.8*	*13.5*	*19.2*	*19.8*	*14.8*	*17.6*	*22.5*	*23.1*	*11.3*	*13.1*	*17.8*	*18.0*
Heat	*0.3*	*0.5*	*1.1*	*1.1*	–	*0.1*	*0.5*	*0.5*	–	–	*0.1*	*0.1*	*0.8*	*1.2*	*2.3*	*2.3*

Table A18 (continued)

Energy Balances and Key Indicators for IEA and Regions

	IEA Total				North America				Pacific				IEA Europe			
	1973	1979	1997	1998	1973	1979	1997	1998	1973	1979	1997	1998	1973	1979	1997	1998
DEMAND																Unit: Mtoe
TOTAL INDUSTRY[6]	**1039.1**	**1071.9**	**1057.9**	**1050.2**	**458.4**	**488.8**	**491.1**	**483.4**	**160.0**	**154.9**	**177.7**	**173.2**	**420.7**	**428.2**	**389.1**	**393.7**
Coal[1]	139.1	125.2	96.7	94.3	35.2	31.3	28.1	29.3	23.5	22.9	25.6	23.4	80.3	71.0	43.1	41.6
Oil	507.2	525.0	412.8	407.4	182.4	229.7	181.8	177.5	103.5	91.5	86.9	84.7	221.3	203.9	144.0	145.2
Gas	220.8	218.3	260.5	256.2	163.2	135.9	146.4	138.9	3.9	6.0	17.1	17.4	53.8	76.3	97.0	99.8
Comb. Renewables & Wastes[2]	17.9	20.7	39.2	40.9	12.9	13.7	20.9	22.3	1.5	2.1	5.2	5.0	3.5	4.8	13.2	13.6
Geothermal	–	–	0.4	0.4	–	–	–	–	–	–	0.4	0.4	–	–	–	–
Solar/Wind/Other	–	–	0.0	0.0	–	–	–	–	–	–	–	–	–	–	0.0	0.0
Electricity	151.5	178.3	236.1	239.6	64.6	77.2	108.0	109.4	27.5	32.3	42.5	42.3	59.3	68.9	85.5	87.9
Heat	2.5	4.4	12.2	11.5	0.1	1.0	6.0	6.0	–	–	–	–	2.5	3.4	6.3	5.4
Fuel Shares (%)																
Coal	*13.4*	*11.7*	*9.1*	*9.0*	*7.7*	*6.4*	*5.7*	*6.1*	*14.7*	*14.8*	*14.4*	*13.5*	*19.1*	*16.6*	*11.1*	*10.6*
Oil	*48.8*	*49.0*	*39.0*	*38.8*	*39.8*	*47.0*	*37.0*	*36.7*	*64.7*	*59.1*	*48.9*	*48.9*	*52.6*	*47.6*	*37.0*	*36.9*
Gas	*21.3*	*20.4*	*24.6*	*24.4*	*35.6*	*27.8*	*29.8*	*28.7*	*2.4*	*3.9*	*9.6*	*10.0*	*12.8*	*17.8*	*24.9*	*25.4*
Comb. Renewables & Wastes	*1.7*	*1.9*	*3.7*	*3.9*	*2.8*	*2.8*	*4.2*	*4.6*	*0.9*	*1.4*	*2.9*	*2.9*	*0.8*	*1.1*	*3.4*	*3.5*
Geothermal	–	–	–	–	–	–	–	–	–	–	*0.2*	*0.2*	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Electricity	*14.6*	*16.6*	*22.3*	*22.8*	*14.1*	*15.8*	*22.0*	*22.6*	*17.2*	*20.9*	*23.9*	*24.4*	*14.1*	*16.1*	*22.0*	*22.3*
Heat	*0.2*	*0.4*	*1.2*	*1.1*	–	*0.2*	*1.2*	*1.2*	–	–	–	–	*0.6*	*0.8*	*1.6*	*1.4*
TRANSPORT[7]	**694.9**	**790.1**	**1070.5**	**1095.4**	**455.8**	**498.7**	**620.6**	**635.0**	**58.3**	**74.4**	**123.3**	**124.0**	**180.9**	**217.0**	**326.6**	**336.4**
TOTAL OTHER SECTORS[8]	**893.2**	**948.2**	**1059.5**	**1048.7**	**464.9**	**473.1**	**511.5**	**493.9**	**62.2**	**72.3**	**119.2**	**120.7**	**366.1**	**402.8**	**428.8**	**434.2**
Coal[1]	75.6	66.6	17.4	13.9	14.0	14.5	4.0	3.4	2.2	1.2	1.2	1.2	59.3	50.9	12.1	9.2
Oil	389.0	343.3	238.0	230.3	158.1	123.6	73.4	67.3	39.4	41.7	47.8	46.9	191.4	178.0	116.8	116.1
Gas	237.6	284.8	371.5	358.7	185.0	195.7	215.1	197.6	5.7	8.3	16.2	16.6	46.9	80.8	140.2	144.6
Comb. Renewables & Wastes[2]	29.3	40.7	42.5	44.7	10.8	20.1	13.2	14.6	2.0	1.7	3.3	3.3	16.5	18.9	26.0	26.8
Geothermal	–	–	0.3	0.4	–	–	–	–	–	–	0.2	0.2	–	–	0.1	0.2
Solar/Wind/Other	–	0.0	0.4	0.4	–	–	–	–	–	0.0	0.1	0.1	–	0.0	0.3	0.3
Electricity	156.7	202.9	366.3	376.4	97.0	119.2	203.7	208.8	12.8	19.3	49.9	51.9	46.8	64.5	112.7	115.7
Heat	5.0	9.8	23.2	24.0	–	0.0	2.2	2.2	0.0	0.1	0.4	0.5	5.0	9.7	20.5	21.4

Table A18 (continued)

Energy Balances and Key Indicators for IEA and Regions

	IEA Total				North America				Pacific				IEA Europe			
	1973	1979	1997	1998	1973	1979	1997	1998	1973	1979	1997	1998	1973	1979	1997	1998
DEMAND																**Unit: Mtoe**
Fuel Shares (%)																
Coal	*8.5*	*7.0*	*1.6*	*1.3*	*3.0*	*3.1*	*0.8*	*0.7*	*3.6*	*1.7*	*1.0*	*1.0*	*16.2*	*12.6*	*2.8*	*2.1*
Oil	*43.5*	*36.2*	*22.5*	*22.0*	*34.0*	*26.1*	*14.3*	*13.6*	*63.4*	*57.7*	*40.1*	*38.9*	*52.3*	*44.2*	*27.2*	*26.7*
Gas	*26.6*	*30.0*	*35.1*	*34.2*	*39.8*	*41.4*	*42.0*	*40.0*	*9.1*	*11.5*	*13.6*	*13.7*	*12.8*	*20.1*	*32.7*	*33.3*
Comb. Renewables & Wastes	*3.3*	*4.3*	*4.0*	*4.3*	*2.3*	*4.3*	*2.6*	*2.9*	*3.2*	*2.3*	*2.8*	*2.7*	*4.5*	*4.7*	*6.1*	*6.2*
Geothermal	–	–	–	–	–	–	–	–	–	–	*0.2*	*0.2*	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–	–	–	–	*0.1*	*0.1*	–	–	*0.1*	*0.1*
Electricity	*17.5*	*21.4*	*34.6*	*35.9*	*20.9*	*25.2*	*39.8*	*42.3*	*20.7*	*26.7*	*41.8*	*43.0*	*12.8*	*16.0*	*26.3*	*26.6*
Heat	*0.6*	*1.0*	*2.2*	*2.3*	–	–	*0.4*	*0.4*	–	*0.1*	*0.4*	*0.4*	*1.4*	*2.4*	*4.8*	*4.9*
ENERGY TRANSFORMATION AND LOSSES																
ELECTRICITY GENERATION[9]																
INPUT (Mtoe)	**980.0**	**1199.4**	**1368.8**	**1899.9**	**543.3**	**649.8**	**500.3**	**1020.6**	**109.8**	**144.4**	**261.9**	**264.6**	**326.9**	**405.2**	**606.5**	**614.8**
OUTPUT (Mtoe)	**370.1**	**456.0**	**711.4**	**730.3**	**192.3**	**233.8**	**364.9**	**375.4**	**47.2**	**60.0**	**107.2**	**109.1**	**130.7**	**162.2**	**239.3**	**245.9**
(TWh gross)	4303.6	5302.8	8272.7	8492.3	2235.6	2718.8	4243.0	4365.4	548.3	698.1	1246.9	1268.1	1519.7	1885.9	2782.7	2858.7
Output Shares (%)																
Coal	*37.3*	*38.1*	*38.5*	*38.3*	*42.1*	*43.3*	*48.9*	*48.4*	*15.9*	*16.3*	*27.5*	*28.0*	*37.9*	*38.5*	*27.7*	*27.5*
Oil	*25.4*	*19.3*	*6.2*	*6.4*	*15.4*	*12.5*	*2.9*	*3.8*	*62.7*	*45.2*	*15.2*	*13.6*	*26.6*	*19.5*	*7.2*	*7.2*
Gas	*11.9*	*11.3*	*13.6*	*14.5*	*17.0*	*13.4*	*12.4*	*13.4*	*2.5*	*11.6*	*18.7*	*19.3*	*7.8*	*8.2*	*13.1*	*14.0*
Comb. Renewables & Wastes	*0.2*	*0.2*	*1.6*	*1.7*	*0.0*	*0.1*	*1.7*	*1.7*	*0.1*	*0.1*	*2.1*	*2.0*	*0.4*	*0.5*	*1.5*	*1.6*
Nuclear	*4.4*	*10.8*	*23.9*	*23.8*	*4.7*	*11.2*	*17.7*	*18.0*	*1.8*	*10.1*	*25.6*	*26.2*	*4.9*	*10.3*	*32.8*	*31.7*
Hydro	*20.7*	*20.2*	*15.6*	*14.8*	*20.6*	*19.4*	*16.0*	*14.3*	*16.9*	*16.4*	*10.5*	*10.5*	*22.2*	*22.8*	*17.3*	*17.4*
Geothermal	*0.1*	*0.2*	*0.3*	*0.3*	*0.1*	*0.2*	*0.4*	*0.4*	*0.3*	*0.3*	*0.5*	*0.5*	*0.2*	*0.1*	*0.1*	*0.2*
Solar/Wind/Other	*0.0*	*0.0*	*0.2*	*0.2*	–	–	*0.1*	*0.1*	–	–	*0.0*	*0.0*	*0.0*	*0.0*	*0.3*	*0.5*
TOTAL LOSSES (Mtoe)	**961.0**	**1096.7**	**895.3**	**1508.5**	**529.2**	**605.8**	**213.1**	**818.7**	**114.7**	**134.2**	**216.5**	**218.7**	**317.1**	**356.7**	**465.7**	**471.1**
of which:																
Electricity and Heat Generation[10]	601.2	727.7	524.1	1128.7	351.0	415.0	32.6	634.6	62.6	84.2	154.2	155.0	187.6	228.6	337.3	339.1
Other Transformation	80.9	98.1	58.7	59.8	1.3	33.4	7.4	6.1	31.0	24.4	26.5	27.6	48.5	40.3	24.8	26.1
Own Use and Losses[11]	279.0	270.9	312.5	320.0	176.9	157.4	173.1	178.0	21.1	25.6	35.7	36.1	81.0	87.9	103.6	105.9
Statistical Differences	**–16.8**	**0.4**	**12.0**	**–16.1**	**–10.9**	**5.6**	**8.0**	**–14.8**	**–5.7**	**–3.4**	**3.1**	**–4.3**	**–0.2**	**–1.9**	**0.9**	**3.1**

Table A18 (continued)

Energy Balances and Key Indicators for IEA and Regions

	IEA Total 1973	IEA Total 1979	IEA Total 1997	IEA Total 1998	North America 1973	North America 1979	North America 1997	North America 1998	Pacific 1973	Pacific 1979	Pacific 1997	Pacific 1998	IEA Europe 1973	IEA Europe 1979	IEA Europe 1997	IEA Europe 1998
INDICATORS																
GDP (billion 1990 US$)	10768	12643	19418	19849	4042	4748	7428	7710	1805	2199	3816	3738	4921	5695	8175	8401
Population (millions)	775	812	914	920	234	249	297	299	125	134	148	149	416	429	469	471
TPES/GDP[12]	0.33	0.31	0.24	0.24	0.47	0.44	0.33	0.31	0.22	0.20	0.17	0.17	0.26	0.25	0.20	0.20
Energy Production/TPES	0.64	0.66	0.74	0.74	0.87	0.84	0.85	0.85	0.26	0.30	0.50	0.53	0.40	0.50	0.66	0.64
Per Capita TPES[13]	4.61	4.81	5.11	5.10	8.09	8.31	8.16	8.07	3.11	3.24	4.31	4.24	3.09	3.27	3.43	3.48
Oil Supply/GDP[12]	0.18	0.16	0.10	0.10	0.22	0.21	0.13	0.12	0.16	0.13	0.08	0.08	0.15	0.13	0.08	0.08
TFC/GDP[12]	0.24	0.22	0.16	0.16	0.34	0.31	0.22	0.21	0.16	0.14	0.11	0.11	0.20	0.18	0.14	0.14
Per Capita TFC[13]	3.39	3.46	3.49	3.47	5.88	5.86	5.47	5.38	2.24	2.26	2.83	2.80	2.33	2.44	2.44	2.47
Energy-Related CO_2 Emissions (Mt CO_2)[14]	9903.60	10465.27	11197.87	11156.86	5070.37	5406.89	6003.85	5947.31	1104.04	1153.92	1530.54	1497.21	3729.19	3904.46	3663.48	3712.34
CO_2 Emissions from Marine Bunkers (Mt CO_2)	223.81	235.18	228.38	232.99	29.39	83.03	77.01	76.25	60.11	45.86	19.74	20.83	134.31	106.29	131.63	135.91
GROWTH RATES (% per year)																
	73–79	**79–98**	**90–98**	**97–98**	**73–79**	**79–98**	**90–98**	**97–98**	**73–79**	**79–98**	**90–98**	**97–98**	**73–79**	**79–98**	**90–98**	**97–98**
TPES	**1.5**	**1.0**	**1.7**	**0.3**	**1.5**	**0.9**	**1.8**	**–0.2**	**1.8**	**2.1**	**2.3**	**–1.2**	**1.5**	**0.9**	**1.2**	**1.7**
Coal	1.4	0.8	–0.0	–2.2	2.9	1.9	1.7	–2.5	–1.0	3.0	2.5	–1.6	0.5	–1.5	–3.9	–1.9
Oil	0.6	–0.2	1.4	0.9	1.3	–0.1	1.7	1.5	0.7	0.1	0.6	–3.7	–0.1	–0.4	1.4	2.3
Gas	1.3	1.6	3.2	0.2	–1.0	0.4	1.9	–2.6	20.2	6.5	4.0	3.3	7.5	3.2	5.2	4.2
Comb. Renewables & Wastes	4.4	3.0	3.0	4.7	4.8	2.0	2.9	6.5	2.3	6.9	2.3	–0.4	3.9	4.1	3.3	3.1
Nuclear	20.3	7.3	2.9	2.3	19.7	5.3	2.0	4.9	39.1	9.0	7.4	4.1	17.4	8.9	2.4	–0.5
Hydro	3.1	0.9	1.5	–2.9	2.3	1.0	1.3	–8.2	3.7	0.8	0.6	1.8	4.1	0.8	1.9	3.3
Geothermal	5.2	6.5	1.6	3.0	9.0	7.6	–0.6	3.1	4.7	7.0	6.6	–0.2	0.1	3.0	4.3	9.0
Solar/Wind/Other	3.2	21.4	18.4	22.2	–	–	3.9	–9.7	–	11.4	2.6	5.4	–1.4	21.6	29.1	34.3
TFC	**1.1**	**0.7**	**1.5**	**0.2**	**1.0**	**0.6**	**1.6**	**–0.7**	**1.2**	**1.8**	**2.1**	**–0.5**	**1.3**	**0.6**	**1.3**	**1.7**
Electricity Consumption	3.6	2.7	2.6	2.2	3.3	2.7	2.8	2.1	4.1	3.4	3.0	2.0	3.8	2.4	2.2	2.6
Energy Production	2.0	1.7	1.6	0.2	0.8	1.0	1.0	0.5	4.2	5.4	4.6	4.0	5.1	2.3	1.9	–1.5
Net Oil Imports	0.5	–1.1	1.1	2.9	6.2	0.6	4.5	5.8	0.5	–0.3	0.2	–7.8	–2.3	–3.0	–1.6	8.3
GDP	2.7	2.5	2.5	2.2	2.7	2.7	3.3	3.8	3.4	3.0	1.8	–2.0	2.5	2.2	2.0	2.8
Growth in the TPES/GDP Ratio	–1.2	–1.5	–0.8	–1.8	–1.2	–1.8	–1.5	–3.8	–1.5	–0.8	0.5	0.9	–1.0	–1.3	–0.8	–1.0
Growth in the TFC/GDP Ratio	–1.5	–1.8	–0.9	–2.0	–1.7	–2.1	–1.7	–4.3	–2.1	–1.1	0.3	1.5	–1.1	–1.6	–0.7	–1.0

Table A18 (Footnotes)

1. Includes lignite and peat.
2. Comprises solid biomass and animal products, gas/liquids from biomass, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.
3. Other includes tide, wave and ambient heat used in heat pumps.
4. Total net imports include combustible renewables and wastes.
5. Total supply of electricity represents net trade. A negative number indicates that exports are greater than imports.
6. Includes non-energy use.
7. Includes less than 1% non-oil fuels.
8. Includes residential, commercial, public service and agricultural sectors.
9. Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.
10. Losses arising in the production of electricity and heat at public utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 33% for nuclear, 10% for geothermal and 100% for hydro.
11. Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.
12. Toe per thousand US dollars at 1990 prices and exchange rates.
13. Toe per person.
14. "Energy-related CO_2 emissions" specifically means CO_2 from the combustion of the fossil fuel components of TPES (i.e. coal and coal products, peat, crude oil and derived products and natural gas), while CO_2 emissions from the remaining components of TPES (i.e. electricity from hydro, other renewables and nuclear) are zero. Emissions from the combustion of biomass-derived fuels are not included, in accordance with the IPCC greenhouse gas inventory methodology. TPES, by definition, excludes international marine bunkers. INC-IX decided in February 1994 that emissions from international marine and aviation bunkers should not be included in national totals but should be reported separately, as far as possible. CO_2 emissions from bunkers are those quantities of fuels delivered for international *marine* bunkers and the emissions arising from their use. Data for deliveries of fuel to international *aviation* bunkers are not generally available to the IEA, and, as a result, these emissions have not been deducted from the national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 1998 and applying this factor to forecast energy supply. Future coal emissions are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

B

ANNEX

GOVERNMENT ENERGY R&D BUDGETS

Table B1

IEA Government R&D Budgets in National Currencies

(millions except for Italian, Japanese and Turkish currencies, which are in billions)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	397.9	369.4	378.5	362.4	367.6	315.7	322.0	322.0	300.6	265.9	249.6	248.4
United States	2 159.7	2 164.8	2 497.0	2 598.4	2 261.7	2 264.0	2 441.6	2 409.1	2 149.9	1 965.7	2 024.6	2 285.5
Australia	..	91.7	..	..	..	110.4	..	116.3	..	157.6	..	..
Japan	276.8	375.6	367.7	383.0	392.9	404.7	433.9	445.7	459.1	437.7	441.8	437.9
New Zealand	..	..	2.0	2.0	..	4.7	3.8	4.4	5.3	5.1	6.4	6.1
Austria	318.8	187.6	137.6	245.0	210.7	286.9	324.6	332.1	334.3	354.1	376.8	..
Belgium[1]	2 529.0	1 825.0	..	358.4	387.6	671.3	702.5	1 765.8	2 277.1	2 200.5	2 839.3	..
Luxembourg[2]	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	..	154.5	215.0	262.0	310.0	302.0	259.0	245.1	217.6	258.3	316.2	312.6
Finland	..	..	193.3	214.4	227.4	236.4	286.3	346.0	333.6	471.9	486.8	..
France	3 278.1	3 115.3	3 018.9	3 058.4	2 914.4	2 944.9	2 783.0	3 292.4	3 169.3	3 202.3	3 457.3	4 048.0
Germany[3]	901.7	799.1	856.0	863.0	710.1	715.9	586.8	512.8	557.4	507.0	547.8	527.1
Greece	2 341.3	1 546.2	1 487.0	1 577.1	1 208.0	1 125.0	1 138.9	2 091.9	2 560.3	4 863.4	..	..
Hungary	..	..	..	..	..	..	..	44.6	10.5	..	122.0	75.1
Ireland	2.5	..	0.7	..	..	..	..	..	..	..	..	..
Italy	1 011.8	844.8	798.6	788.7	..	444.7	436.5	472.1	460.5	429.6	430.0	..
Netherlands	245.6	279.9	304.1	304.1	299.6	338.4	310.8	303.8	263.8	293.0	270.2	..
Norway	244.4	313.7	323.7	368.5	391.9	366.5	355.7	304.4	288.3	281.8	277.4	372.1
Portugal	827.0	1 105.6	1 427.4	1 024.8	943.9	646.6	547.8	273.3	350.3	235.4	322.7	399.6
Spain	6 769.0	7 095.0	5 409.1	12 975.8	10 985.9	9 658.3	10 657.0	9 988.0	9 867.0	10 037.0	7 883.1	8 625.0
Sweden	533.0	585.1	591.0	567.0	714.1	553.1	598.0	452.9	413.1	467.0	440.0	..
Switzerland	142.8	165.4	187.2	199.0	220.6	223.3	220.8	215.1	206.7	196.9	..	..
Turkey[4]	5.8	8.9	5.2	9.7	23.6	41.2	42.1	189.1	274.8	1 608.9	1 387.8	1 711.5
United Kingdom	228.0	190.2	166.7	142.9	133.5	98.8	50.9	52.9	36.4	49.3	43.8	47.9
European Commission[5]	..	..	..	..	..	..	..	..	..	..	..	..

1. Figures for 1991 refer to Wallonia only. From 1991 to 1994, nuclear data are not available and therefore are not included in the budget.
2. Luxembourg has no energy R&D programme.
3. Data do not include the new Laender of Germany prior to 1992.
4. The strong increase in the budget is due to high inflation rate in Turkey and to new RD&D activities.
5. The European Commission is revising its current RD&D series.

Source: Country submissions.

Table B2

IEA Government R&D Budgets in 1999 National Currencies

(millions except for Italian, Japanese and Turkish currencies, which are in billions)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	483.5	429.2	426.9	398.0	398.5	337.2	340.2	332.8	305.7	268.2	253.1	248.4
United States	2 798.2	2 700.8	3 000.4	3 018.0	2 572.4	2 506.7	2 650.0	2 558.7	2 242.4	2 016.0	2 052.1	2 285.5
Australia	..	109.3	..	..	..	118.8	..	122.3	..	160.3	..	..
Japan	297.3	395.2	378.4	383.7	386.8	396.2	424.0	438.4	458.2	436.4	438.9	437.9
New Zealand	..	..	2.3	2.3	..	5.1	4.1	4.6	5.5	5.3	6.5	6.1
Austria	418.2	239.6	169.8	291.4	240.2	318.3	350.1	349.9	346.5	361.3	380.6	..
Belgium[1]	3 293.7	2 264.6	..	419.9	438.0	731.1	751.1	1 855.9	2 355.5	2 243.2	2 869.3	..
Luxembourg[2]	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	..	187.1	251.8	299.3	346.4	335.8	284.0	266.2	231.2	269.8	323.4	312.6
Finland	..	..	226.6	247.5	259.7	265.1	315.1	367.4	352.2	488.4	490.9	..
France	4 049.2	3 729.1	3 513.1	3 455.2	3 229.6	3 185.7	2 955.5	3 440.6	3 263.0	3 252.1	3 480.6	4 048.0
Germany[3]	1 173.3	1 015.7	1 054.6	1 023.2	801.8	779.6	623.3	533.8	574.5	518.5	554.2	527.1
Greece	7 663.6	4 426.9	3 528.8	3 123.7	2 084.9	1 695.1	1 542.6	2 581.4	2 941.7	5 236.9	..	..
Hungary	..	..	..	..	..	..	..	80.4	15.6	..	134.1	75.1
Ireland	3.4	..	0.9	..	..	..	..	..	..	..	..	..
Italy	1 669.6	1 309.6	1 143.5	1 049.4	..	544.8	516.7	532.1	493.4	448.7	436.6	..
Netherlands	304.9	343.2	364.5	355.0	341.9	379.0	339.9	326.3	280.0	304.9	276.1	..
Norway	325.4	395.1	392.6	436.5	466.1	426.6	414.9	344.4	312.5	297.5	294.1	372.1
Portugal	1 733.6	2 061.5	2 360.8	1 510.7	1 265.1	812.1	647.7	307.3	383.0	252.2	331.3	399.6
Spain	11 207.4	10 959.6	7 789.7	17 437.7	13 823.0	11 648.9	12 355.0	11 046.7	10 554.1	10 512.2	8 065.4	8 625.0
Sweden	773.6	787.9	732.6	653.3	812.9	612.9	646.9	473.3	425.7	475.6	443.0	..
Switzerland	178.1	200.1	217.2	217.8	235.0	231.7	225.3	217.2	207.8	198.3	..	..
Turkey	2 474.3	2 156.7	791.8	936.7	1 391.9	1 448.5	716.3	1 721.7	1 407.0	4 538.4	2 240.0	1 711.5
United Kingdom	348.6	270.6	220.4	176.9	158.9	114.4	58.1	58.9	39.2	51.6	44.7	47.9
European Commission[4]	..	..	..	..	..	..	..	..	..	..	..	..

1. Figures for 1991 refer to Wallonia only. From 1991 to 1994, nuclear data are not available and therefore are not included in the budget.
2. Luxembourg has no energy R&D programme.
3. Data do not include the new Laender of Germany prior to 1992.
4. The European Commission is revising its current RD&D series.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B3

IEA Government R&D Budgets

(US$ million at 1998 prices and exchange rates)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	1999 exch. rates Unit per $
Canada	325.4	288.8	287.3	267.8	268.2	226.9	229.0	223.9	205.7	180.5	170.3	167.1	1.486
United States	2 798.2	2 700.8	3 000.4	3 018.0	2 572.4	2 506.7	2 650.0	2 558.7	2 242.4	2 016.0	2 052.1	2 285.5	1.000
Australia	..	70.5	..	..	..	76.6	..	78.9	..	103.4	..	..	1.550
Japan	2 609.9	3 469.6	3 322.1	3 369.1	3 396.3	3 478.7	3 722.9	3 849.2	4 022.9	3 831.5	3 853.0	3 844.4	113.9
New Zealand	..	..	1.2	1.2	..	2.7	2.2	2.4	2.9	2.8	3.4	3.2	1.892
Austria	32.4	18.6	13.2	22.6	18.6	24.7	27.1	27.1	26.8	28.0	29.5	..	12.913
Belgium[1]	87.0	59.8	..	11.1	11.6	19.3	19.8	49.0	62.2	59.3	75.8	..	37.856
Luxembourg[2]	–	–	–	–	–	–	–	–	–	–	–	–	37.560
Denmark	..	26.8	36.1	42.9	49.6	48.1	40.7	38.1	33.1	38.7	46.3	44.8	6.980
Finland	..	..	40.6	44.4	46.5	47.5	56.5	65.8	63.1	87.5	88.0	..	5.580
France	657.8	605.8	570.7	561.3	524.6	517.5	480.1	558.9	530.0	528.3	565.4	657.6	6.156
Germany[3]	639.4	553.5	574.7	557.6	436.9	424.8	339.7	290.9	313.1	282.5	302.0	287.2	1.835
Greece	25.1	14.5	11.5	10.2	6.8	5.5	5.0	8.4	9.6	17.1	..	..	305.705
Hungary	..	..	..	..	..	..	..	0.3	0.1	..	0.6	0.3	237.100
Ireland	4.7	..	1.2	..	..	..	..	..	..	..	..	..	0.739
Italy	918.8	720.7	629.3	577.5	..	299.8	284.3	292.8	271.5	246.9	240.3	..	1 817
Netherlands	147.5	165.9	176.3	171.7	165.4	183.3	164.4	157.8	135.4	147.4	133.5	..	2.068
Norway	41.7	50.7	50.4	56.0	59.8	54.7	53.2	44.2	40.1	38.2	37.7	47.7	7.797
Portugal	9.2	11.0	12.5	8.0	6.7	4.3	3.4	1.6	2.0	1.3	1.8	2.1	188.138
Spain	71.8	70.2	49.9	111.7	88.6	74.6	79.1	70.8	67.6	67.3	51.7	55.3	156.100
Sweden	93.6	95.4	88.7	79.1	98.4	74.2	78.3	57.3	51.5	57.6	53.6	..	8.262
Switzerland	118.5	133.1	144.5	144.9	156.3	154.2	149.9	144.5	138.2	131.9	..	..	1.503
Turkey	5.9	5.1	1.9	2.2	3.3	3.5	1.7	4.1	3.4	10.8	5.3	4.1	418 983
United Kingdom	564.0	437.9	356.6	286.2	257.0	185.1	94.0	95.3	63.4	83.5	72.4	77.5	0.618
Total Reported[4]	**9 151.0**	**9 498.8**	**9 369.0**	**9 343.5**	**8 167.1**	**8 412.8**	**8 481.4**	**8 620.3**	**8 285.1**	**7 960.6**	**7 782.7**	**..**	**–**
European Commission[5]	..	..	..	..	..	..	..	..	..	..	..	..	0.939

1. Figures for 1991 refer to Wallonia only. From 1991 to 1994, nuclear data are not available and therefore are not included in the budget.
2. Luxembourg has no energy R&D programme.
3. Data do not include the new Laender of Germany prior to 1992.
4. Yearly totals are not comparable due to missing data.
5. The European Commission is revising its current RD&D series.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B4

IEA Government Budgets on Energy R&D

(per thousand units of GDP)

					R&D/GDP including nuclear research				
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Canada	0.53	0.53	0.44	0.42	0.40	0.37	0.31	0.28	0.27
United States	0.44	0.36	0.35	0.35	0.33	0.28	0.24	0.24	0.26
Australia	..	..	0.26	..	0.24	..	0.30	..	..
Japan	0.84	0.83	0.85	0.91	0.92	0.92	0.86	0.89	0.88
New Zealand	0.03	..	0.06	0.04	0.05	0.06	0.05	0.06	0.06
Austria	0.13	0.10	0.13	0.14	0.14	0.14	0.14	0.14	..
Belgium[1]	0.05	0.05	0.09	0.09	0.22	0.27	0.25	0.31	..
Luxembourg[2]	–	–	–	–	–	–	–	–	–
Denmark	0.31	0.35	0.34	0.27	0.24	0.20	0.23	0.27	0.26
Finland	0.44	0.48	0.49	0.56	0.63	0.58	0.76	0.73	..
France	0.45	0.42	0.42	0.38	0.43	0.40	0.39	0.41	0.46
Germany[3]	0.30	0.23	0.23	0.18	0.15	0.16	0.14	0.15	0.14
Greece	0.10	0.06	0.05	0.05	0.08	0.09	0.15	..	..
Hungary	..	..	..	..	0.01	0.00	..	0.01	0.01
Ireland	..	..	..	..	..	..	..	..	..
Italy	0.55	..	0.29	0.27	0.27	0.25	0.22	0.21	..
Netherlands	0.56	0.53	0.58	0.51	0.47	0.39	0.41	0.36	..
Norway	0.48	0.50	0.44	0.41	0.33	0.28	0.26	0.25	0.33
Portugal	0.09	0.07	0.05	0.04	0.02	0.02	0.01	0.02	0.02
Spain	0.24	0.19	0.16	0.16	0.14	0.13	0.13	0.09	0.10
Sweden	0.39	0.50	0.38	0.39	0.27	0.24	0.27	0.24	..
Switzerland	0.60	0.64	0.64	0.62	0.59	0.57	0.53	..	..
Turkey	0.02	0.02	0.02	0.01	0.02	0.02	0.06	0.02	0.02
United Kingdom	0.25	0.22	0.15	0.08	0.07	0.05	0.06	0.05	0.05
					R&D/GDP excluding nuclear research				
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Canada	0.30	0.28	0.21	0.20	0.19	0.21	0.17	0.17	0.16
United States	0.30	0.27	0.28	0.29	0.27	0.24	0.21	0.21	0.24
Australia	..	..	0.26	..	0.23	..	0.30	..	..
Japan	0.17	0.17	0.17	0.23	0.23	0.22	0.21	0.26	0.26
New Zealand	0.03	..	0.06	0.04	0.05	0.06	0.05	0.06	0.06
Austria	0.11	0.09	0.12	0.14	0.13	0.13	0.13	0.13	..
Belgium[1]	0.05	0.05	0.09	0.09	0.10	0.10	0.08	0.09	..
Luxembourg[2]	–	–	–	–	–	–	–	–	–
Denmark	0.29	0.33	0.32	0.26	0.24	0.20	0.23	0.24	0.23
Finland	0.35	0.39	0.40	0.49	0.56	0.50	0.69	0.65	..
France	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.04
Germany[3]	0.11	0.10	0.11	0.08	0.06	0.07	0.06	0.06	0.06
Greece	0.10	0.06	0.05	0.05	0.08	0.08	0.15	..	..
Hungary	..	..	..	..	0.01	0.00	..	0.01	0.00
Ireland	..	..	..	..	..	..	..	..	..
Italy	0.40	..	0.15	0.15	0.16	0.14	0.12	0.12	..
Netherlands	0.45	0.35	0.45	0.39	0.36	0.34	0.36	0.31	..
Norway	0.42	0.43	0.38	0.35	0.27	0.23	0.21	0.20	0.28
Portugal	0.06	0.05	0.03	0.01	0.02	0.02	0.01	0.02	0.02
Spain	0.17	0.12	0.10	0.09	0.08	0.07	0.07	0.05	0.06
Sweden	0.32	0.42	0.30	0.31	0.24	0.21	0.24	0.22	..
Switzerland	0.39	0.45	0.44	0.44	0.43	0.40	0.37	..	..
Turkey	0.02	0.02	0.01	0.00	0.02	0.01	0.05	0.02	0.01
United Kingdom	0.07	0.08	0.07	0.04	0.04	0.03	0.04	0.03	0.04

1. Figures for the 1991 R&D budget refer to Wallonia while GDP refers to all of Belgium. From 1991 to 1994, nuclear data are not available and therefore are not included in the budget.
2. Luxembourg has no energy R&D programme.
3. Data do not include the new Laender of Germany prior to 1992.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B5

IEA Government R&D Budgets for Conservation

(US$ million at 1999 prices and exchange rates)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	31.1	29.9	29.9	27.1	23.0	25.1	37.3	36.5	37.4	36.2	36.9	38.0
United States	186.3	197.8	217.7	251.8	324.0	340.5	464.4	537.6	430.9	397.6	427.0	488.0
Australia	..	5.0	..	..	..	4.6	..	9.4	..	6.7	..	..
Japan[1]	76.8	5.4	3.7	18.9	18.8	29.0	243.0	259.5	298.2	290.8	467.3	564.8
New Zealand	..	..	0.6	0.6	..	0.4	0.4	0.6	0.5	0.5	0.2	0.5
Austria	13.1	6.4	5.9	7.1	5.9	8.8	10.9	9.9	9.9	9.3	7.4	..
Belgium[2]	4.1	1.0	..	7.6	3.3	7.0	9.6	8.6	11.0	9.7	14.3	..
Luxembourg[3]	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	..	7.4	10.6	8.3	9.4	6.9	5.7	4.9	5.1	7.8	8.8	9.8
Finland	..	..	9.6	14.2	14.6	15.3	16.8	23.0	22.5	37.4	45.7	..
France	15.5	17.1	25.4	19.2	18.6	12.1	8.1	7.9	7.1	4.6	6.5	12.3
Germany[4]	19.9	18.7	17.9	18.0	12.7	12.0	13.8	15.8	23.0	14.9	13.5	11.7
Greece	1.8	1.5	3.3	1.3	0.2	0.2	1.4	1.6	2.1	5.2	..	..
Hungary	..	..	..	..	..	..	..	–	–	..	–	–
Ireland	2.0	..	0.2	..	..	..	..	..	..	..	..	..
Italy	53.2	38.7	47.9	55.8	..	54.4	51.4	54.2	55.0	50.8	50.6	..
Netherlands	42.3	44.9	57.1	55.6	43.7	62.7	48.2	52.1	51.5	55.8	48.7	..
Norway	9.9	10.7	10.0	11.9	14.0	13.4	7.7	1.8	1.7	1.6	1.5	1.4
Portugal	1.9	1.6	2.5	1.1	0.5	1.0	0.4	0.8	0.7	0.6	0.1	0.2
Spain	4.7	1.9	3.6	41.9	12.2	4.7	7.7	6.0	3.6	3.6	6.8	13.2
Sweden	26.2	30.3	28.8	26.9	30.3	24.3	23.0	20.8	24.2	18.0	15.1	..
Switzerland	14.9	18.3	18.8	21.1	23.7	25.1	28.6	27.2	25.4	20.1	..	..
Turkey	1.5	1.4	0.3	–	–	1.2	–	0.2	0.2	0.1	0.2	0.2
United Kingdom	54.2	49.2	35.7	27.1	33.5	37.9	4.3	2.6	2.3	1.7	0.9	1.0
Total Reported[5]	**559.4**	**487.2**	**529.5**	**615.6**	**588.6**	**686.6**	**982.4**	**1 081.0**	**1 012.2**	**972.9**	**1 151.4**	**..**

1. The items included in Conservation were expanded in 1994. Earlier budgetary data are not comparable.
2. Figures for 1991 refer to Wallonia only.
3. Luxembourg has no energy R&D programme.
4. Data do not include the new Laender of Germany prior to 1992.
5. Yearly totals are not comparable due to missing data.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B6

IEA Government R&D Budgets for Oil & Gas
(US$ million at 1999 prices and exchange rates)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	112.3	86.9	87.8	80.7	67.5	48.3	38.8	35.9	42.3	35.6	36.5	33.9
United States	60.8	62.0	71.4	92.5	98.4	175.5	106.5	117.6	80.9	70.0	74.1	75.1
Australia	..	18.1	..	..	..	33.0	..	27.5	..	57.5	..	..
Japan	95.6	78.0	93.5	107.5	113.0	119.1	126.0	143.8	143.2	139.1	104.3	78.9
New Zealand	..	..	–	–	..	1.3	0.5	0.4	0.5	0.5	0.6	0.6
Austria	0.9	0.5	0.1	0.6	0.8	0.4	0.2	0.3	0.6	0.3	0.3	..
Belgium[1]	–	–	..	–	–	–	–	–	0.1	0.1	–	..
Luxembourg[2]	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	..	–	–	–	2.6	3.0	3.3	3.5	2.9	2.5	2.1	2.5
Finland	..	..	–	–	–	–	–	–	–	2.2	2.5	..
France	44.1	42.8	41.6	37.8	36.2	33.6	33.5	32.1	31.6	31.2	30.9	30.7
Germany[3]	15.7	15.1	15.3	7.6	7.0	4.1	2.9	0.8	–	–	–	–
Greece	0.1	0.1	–	–	0.1	0.1	0.6	1.1	1.2	1.8	..	..
Hungary	..	..	..	..	..	..	..	–	–	..	–	–
Ireland	0.2	..	0.2	..	..	..	..	..	..	..	..	..
Italy	–	–	–	–	..	–	–	–	–	–	–	..
Netherlands	0.7	0.7	0.7	0.7	6.9	9.8	10.3	12.6	12.5	8.6	8.4	..
Norway	22.3	21.6	19.4	16.3	17.0	15.0	23.7	22.0	19.3	18.4	17.6	28.7
Portugal	0.1	–	–	–	–	–	0.3	0.2	0.1	0.1	0.1	0.1
Spain	–	–	–	–	–	–	–	–	–	–	–	0.1
Sweden	1.7	3.7	3.9	2.0	1.2	–	–	–	–	–	–	..
Switzerland	4.4	7.2	8.6	11.0	12.1	12.1	11.5	10.9	8.5	9.3	..	..
Turkey	0.7	0.7	0.2	–	0.3	0.1	0.1	2.8	2.0	4.1	0.8	0.6
United Kingdom	51.0	23.2	11.2	1.6	6.9	6.4	5.0	10.8	5.0	7.5	6.0	4.6
Total Reported[4]	**410.7**	**360.5**	**353.9**	**358.2**	**369.9**	**461.7**	**363.0**	**422.2**	**350.6**	**388.6**	**284.0**	**..**

1. Figures for 1991 refer to Wallonia only.
2. Luxembourg has no energy R&D programme.
3. Data do not include the new Laender of Germany prior to 1992.
4. Yearly totals are not comparable due to missing data.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B7

IEA Government R&D Budgets for Coal

(US$ million at 1999 prices and exchange rates)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	28.1	19.9	24.1	23.4	17.7	10.7	7.7	9.7	7.0	2.4	3.9	3.9
United States	495.2	499.6	964.2	796.8	350.4	262.1	420.4	203.1	277.8	98.9	105.8	122.2
Australia	..	15.6	..	..	..	13.9	..	13.4	..	17.1	..	..
Japan	372.3	289.0	282.1	230.3	236.4	269.2	266.8	246.7	221.6	196.9	178.0	136.1
New Zealand	..	..	0.2	0.2	..	0.2	0.3	0.3	0.4	0.4	0.4	0.3
Austria	0.1	0.2	0.1	0.4	0.5	1.2	0.7	0.6	1.2	1.6	0.4	..
Belgium[1]	5.0	4.9	..	1.0	1.3	1.2	1.7	1.4	1.5	2.2	0.5	..
Luxembourg[2]	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	..	–	4.2	6.1	6.4	5.3	4.7	2.8	0.8	–	–	–
Finland	..	..	5.4	4.9	4.7	3.1	3.8	3.3	3.6	3.6	3.0	..
France	6.0	5.8	5.7	5.5	5.4	5.6	5.5	5.6	5.2	5.1	0.1	–
Germany[3]	119.6	86.9	79.6	59.7	43.3	25.6	18.7	13.5	3.7	1.4	1.3	0.8
Greece	2.5	2.1	2.1	1.5	0.6	0.4	0.4	0.8	0.7	2.2	..	..
Hungary	..	..	..	..	..	..	..	–	–	..	–	–
Ireland	0.2	..	0.1	..	..	..	..	..	..	..	..	..
Italy	6.3	0.5	–	–	..	–	–	–	–	–	–	..
Netherlands	15.9	30.8	13.1	12.8	7.2	7.5	6.5	3.4	3.3	3.0	3.3	..
Norway	–	0.1	0.1	0.1	0.1	0.1	–	–	–	–	–	–
Portugal	0.8	1.7	1.1	0.8	1.6	0.6	–	–	–	–	0.1	0.2
Spain	5.1	2.1	2.8	3.5	2.4	1.5	4.2	4.7	4.1	3.9	2.6	0.8
Sweden	4.7	3.3	3.1	1.4	1.5	0.8	0.7	0.5	0.2	0.1	0.1	..
Switzerland	0.6	0.8	1.5	1.2	0.2	0.1	0.3	0.4	–	–	..	..
Turkey	1.2	1.3	0.8	2.0	0.7	0.4	0.1	0.2	0.1	3.2	1.7	1.1
United Kingdom	6.0	6.3	25.1	8.4	7.7	13.7	6.0	8.8	8.4	4.1	2.2	2.8
Total Reported[4]	**1 069.5**	**970.8**	**1 415.3**	**1 160.0**	**688.1**	**623.3**	**748.6**	**519.0**	**539.7**	**346.0**	**303.3**	**..**

1. Figures for 1991 refer to Wallonia only.
2. Luxembourg has no energy R&D programme.
3. Data do not include the new Laender of Germany prior to 1992.
4. Yearly totals are not comparable due to missing data.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B8

IEA Government R&D Budgets for Conventional Nuclear

(US$ million at 1999 prices and exchange rates)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	116.4	115.5	113.2	105.7	115.4	112.3	112.5	110.0	83.6	81.2	67.9	67.3
United States	897.9	730.2	644.5	651.5	248.5	129.5	103.4	89.5	40.8	57.9	20.3	18.5
Australia	..	14.4	..	..	..	0.8	..	5.3	..	0.8	..	..
Japan	832.0	1 817.1	1 782.5	1 861.8	1 905.5	1 967.2	2 021.4	2 217.6	2 358.2	2 267.0	2 216.6	2 234.0
New Zealand	..	..	–	–	..	–	–	–	–	–	–	–
Austria	1.1	0.9	0.5	0.4	0.4	0.6	0.6	0.5	0.9	0.6	–	..
Belgium	33.0	34.3	..	..	..	..	..	23.8	34.9	35.6	48.5	37.4
Luxembourg[1]	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	..	–	2.7	0.7	0.8	0.8	0.8	0.5	0.5	0.5	2.9	2.9
Finland	..	..	8.3	8.9	8.9	8.4	7.2	6.1	7.8	7.1	7.5	..
France	467.1	461.2	414.7	408.5	384.3	377.6	354.3	454.9	428.8	435.7	469.5	548.9
Germany[2]	172.8	140.6	166.4	190.8	101.5	90.2	74.2	72.8	57.0	40.4	38.6	30.5
Greece	0.1	0.4	0.1	0.1	–	–	0.2	0.3	0.3	0.2	..	..
Hungary	..	..	..	..	..	..	..	–	–	..	0.2	0.3
Ireland	–	..	–	..	..	..	..	..	..	..	..	..
Italy	162.4	103.2	90.6	59.4	..	52.4	52.7	42.0	37.9	37.4	33.5	..
Netherlands	24.5	23.5	23.0	22.4	31.0	25.3	21.9	24.9	12.4	11.7	13.0	..
Norway	3.4	3.0	2.9	7.7	7.9	8.0	7.5	7.6	7.2	7.0	7.9	7.4
Portugal	2.0	2.3	2.0	1.3	1.1	0.3	2.2	0.1	0.1	0.1	–	–
Spain	20.7	29.2	16.1	18.0	21.8	19.0	18.0	16.9	16.9	16.6	7.8	7.5
Sweden	1.3	1.2	1.2	1.5	1.6	1.5	1.5	1.4	1.2	1.1	1.1	..
Switzerland	31.2	28.7	28.5	26.5	23.8	23.5	23.6	22.7	19.7	20.2	..	..
Turkey	0.8	0.5	0.3	–	0.9	1.3	0.9	0.6	0.8	1.2	0.8	1.2
United Kingdom	102.3	101.3	44.1	42.2	37.1	20.6	14.8	13.2	7.0	1.7	3.3	3.2
Total Reported[3]	**2 869.0**	**3 607.6**	**3 341.6**	**3 407.4**	**2 890.5**	**2 839.5**	**2 817.7**	**3 110.9**	**3 116.0**	**3 024.0**	**2 939.4**	**..**

1. Luxembourg has no energy R&D programme.
2. Data do not include the new Laender of Germany prior to 1992.
3. Yearly totals are not comparable due to missing data.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B9

IEA Government R&D Budgets for Nuclear Breeders
(US$ million at 1999 prices and exchange rates)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	–	–	–	–	–	–	–	–	–	–	0.2	0.2
United States	–	–	–	–	–	–	–	–	–	–	–	–
Australia	..	–	..	..	..	–	..	–	..	–	..	..
Japan	673.4	744.2	624.4	568.5	508.2	505.1	454.9	355.6	331.4	285.5	245.3	225.2
New Zealand	..	..	–	–	..	–	–	–	–	–	–	–
Austria	–	–	–	–	–	–	–	–	–	–	–	..
Belgium	32.8	11.2	..	..	..	..	..	–	–	–	–	..
Luxembourg[1]	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	..	–	–	–	–	–	–	–	–	–	..	..
Finland	..	..	–	–	–	0.1	–	0.9	–	–	–	..
France	54.4	23.9	28.7	40.4	28.8	45.9	36.7	15.6	15.1	12.0	22.1	20.3
Germany[2]	69.6	58.9	44.4	24.5	4.2	–	–	–	–	–	–	–
Greece	–	–	–	–	–	–	–	–	–	–	..	..
Hungary	..	..	..	..	..	..	..	–	–	..	–	–
Ireland	–	..	–	..	..	..	..	..	..	..	..	..
Italy	150.4	12.8	–	–	..	–	–	–	–	–	–	..
Netherlands	–	–	1.7	1.7	0.5	0.5	0.3	0.3	–	–	–	..
Norway	–	–	–	–	–	–	–	–	–	–	–	–
Portugal	–	–	–	–	–	–	–	–	–	–	–	–
Spain	–	–	–	–	–	–	–	–	–	–	–	–
Sweden	4.0	3.7	3.5	4.5	4.8	4.6	4.4	4.1	3.5	3.2	3.2	..
Switzerland	1.2	1.0	1.3	1.0	1.3	1.2	0.5	0.9	0.9	0.3	..	..
Turkey	–	–	–	–	–	–	–	–	–	–	–	–
United Kingdom	204.2	163.1	152.0	120.9	99.4	46.9	1.8	0.2	–	–	–	–
Total Reported[3]	**1 189.8**	**1 018.7**	**856.1**	**761.5**	**647.2**	**604.2**	**498.7**	**377.5**	**350.9**	**301.0**	**270.8**	**245.6**

1. Luxembourg has no energy R&D programme.
2. Data do not include the new Laender of Germany prior to 1992.
3. Yearly totals are not comparable due to missing data.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B10

IEA Government R&D Budgets for Nuclear Fusion
(US$ million at 1999 prices and exchange rates)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	14.4	6.6	9.8	9.2	9.3	6.0	6.0	5.8	6.5	–	2.4	0.2
United States	428.7	385.6	374.6	326.4	377.8	371.0	356.7	391.3	249.2	225.1	220.3	217.2
Australia	..	2.7	..	..	..	–	..	–	..	–	..	..
Japan	290.7	291.9	285.9	262.2	280.8	302.7	305.8	314.9	351.9	328.9	265.2	259.3
New Zealand	..	..	–	–	..	–	–	–	–	–	–	–
Austria	1.6	1.4	0.6	2.2	1.6	1.9	1.2	1.2	0.7	1.2	2.6	..
Belgium	7.1	6.5	..	..	..	..	..	3.5	4.9	5.1	5.3	5.9
Luxembourg[1]	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	..	3.3	3.0	2.0	2.1	1.3	–	–	–	–	1.8	1.9
Finland	..	..	–	–	–	–	–	–	1.0	1.6	1.1	..
France	60.8	46.5	45.7	41.8	43.6	37.1	36.6	37.5	37.3	36.6	32.2	32.0
Germany[2]	143.3	133.3	133.1	132.0	134.8	137.0	118.2	101.2	108.2	118.3	131.8	134.1
Greece	0.1	0.1	0.1	0.1	–	–	–	–	–	–	..	..
Hungary	..	..	..	..	..	..	..	–	–	..	–	–
Ireland	0.1	..	–	..	..	..	..	..	..	..	..	..
Italy	128.5	115.0	120.8	98.9	..	85.7	69.3	70.0	76.3	74.7	71.5	..
Netherlands	12.0	12.7	10.7	10.4	25.4	14.3	16.1	14.0	5.9	7.6	6.7	..
Norway	–	–	–	–	–	–	–	–	–	–	–	–
Portugal	–	–	3.1	1.7	1.0	0.9	–	–	–	–	–	–
Spain	6.5	7.1	7.9	11.3	9.7	10.2	16.4	15.6	15.6	15.5	14.4	12.8
Sweden	10.8	11.3	10.4	9.4	9.2	9.6	10.0	1.8	1.7	1.4	1.4	..
Switzerland	22.7	24.7	27.0	23.7	22.7	22.2	19.1	16.9	19.8	20.5	..	..
Turkey	–	–	–	–	–	–	–	–	–	–	–	–
United Kingdom	62.2	55.5	46.8	40.2	31.4	30.0	29.6	28.6	20.9	28.8	21.5	22.7
Total Reported[3]	**1 189.5**	**1 104.3**	**1 079.6**	**971.4**	**949.3**	**1 029.8**	**984.9**	**1 002.5**	**899.9**	**865.3**	**778.0**	**..**

1. Luxembourg has no energy R&D programme.
2. Data do not include the new Laender of Germany prior to 1992.
3. Yearly totals are not comparable due to missing data.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B11

IEA Government R&D Budgets for Renewables

(US$ million at 1999 prices and exchange rates)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	13.7	11.4	9.5	9.1	10.4	9.3	10.8	10.6	10.5	8.1	8.4	9.3
United States	159.6	140.9	130.6	174.2	244.7	233.6	239.9	290.0	214.1	202.0	248.0	258.8
Australia	..	4.3	..	..	..	7.6	..	3.6	..	5.4	..	..
Japan	155.3	127.1	126.0	122.4	117.1	121.7	112.4	113.3	116.1	115.5	127.3	128.3
New Zealand	..	..	0.4	0.4	..	0.7	0.8	0.9	1.2	1.2	1.4	1.2
Austria	5.9	3.3	2.2	5.0	4.2	5.8	7.5	8.8	6.8	8.1	10.6	..
Belgium[1]	2.4	0.6	..	0.3	2.1	2.4	2.5	4.0	2.9	3.3	1.4	..
Luxembourg[2]	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	..	11.2	8.9	18.0	19.2	20.7	18.1	17.0	13.7	17.8	19.4	16.7
Finland	..	..	2.4	1.9	2.1	6.0	5.8	5.9	7.4	12.0	8.8	..
France	9.8	8.4	8.8	8.0	7.8	5.7	5.3	5.2	5.0	3.0	4.1	13.3
Germany[3]	91.3	89.6	106.5	116.6	122.9	134.2	88.6	78.2	97.1	76.0	85.1	73.1
Greece	19.2	9.0	4.4	4.5	4.8	3.4	1.8	3.3	3.1	6.5	..	..
Hungary	..	..	..	..	..	..	..	0.3	0.1	..	–	–
Ireland	1.5	..	0.5	..	..	..	..	..	..	..	..	..
Italy	55.6	42.7	48.6	37.1	..	27.5	31.1	42.4	39.7	36.5	34.0	..
Netherlands	20.4	23.5	35.6	34.7	20.6	20.6	17.8	20.0	19.8	29.4	21.8	..
Norway	2.5	3.2	5.4	9.6	10.6	8.4	6.9	4.5	4.2	4.1	4.8	4.8
Portugal	2.4	3.4	1.8	1.7	2.3	1.5	0.6	0.5	1.1	0.6	1.2	1.3
Spain	13.7	14.6	19.5	16.2	22.2	20.0	14.6	14.2	14.2	14.2	17.7	20.0
Sweden	20.1	20.3	17.1	11.4	27.7	13.9	16.8	13.0	8.2	8.5	13.7	..
Switzerland	19.3	24.1	29.3	31.3	37.2	38.8	36.6	35.7	34.0	36.0	..	..
Turkey	1.2	0.9	0.2	0.1	1.2	0.3	0.4	0.1	0.1	2.0	1.6	0.8
United Kingdom	32.7	32.5	31.5	34.3	31.0	28.4	16.8	16.4	10.8	7.3	5.4	8.5
Total Reported[4]	**626.8**	**570.9**	**589.1**	**636.9**	**688.1**	**710.6**	**635.2**	**688.1**	**610.2**	**597.4**	**614.8**	**..**

1. Figures for 1991 refer to Wallonia only.
2. Luxembourg has no energy R&D programme.
3. Data do not include the new Laender of Germany prior to 1992.
4. Yearly totals are not comparable due to missing data.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B12

Total Reported Government R&D Budgets for Renewable Energy Sources
(US$ million at 1999 prices and exchange rates)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Solar Heating	50.0	50.3	54.5	56.2	248.6	54.5	51.8	49.3	33.5	34.4	26.9	22.7
Solar Photo-Electric	201.1	201.6	205.1	221.6	158.6	377.0	234.6	240.0	215.4	219.1	222.6	201.1
Solar Thermal-Electric	58.0	30.2	44.0	42.9	19.0	23.3	46.6	49.8	43.2	42.6	25.2	25.2
Wind	74.2	84.3	95.8	91.4	69.6	81.7	88.5	111.2	108.4	92.7	96.5	77.4
Ocean	11.9	10.9	12.8	11.8	3.0	4.3	4.0	2.4	2.2	2.3	12.1	3.3
Biomass	128.0	95.8	82.1	106.6	85.5	80.7	133.4	140.4	123.7	124.6	160.7	137.3
Geothermal	103.5	97.4	94.6	102.1	88.6	80.2	65.4	81.4	72.2	71.5	64.8	61.3
Large Hydro (>10 MW)	..	..	..	3.7	7.8	7.4	9.2	11.9	8.5	6.8	4.1	5.3
Small Hydro (<10 MW)	0.2	0.4	0.3	0.5	7.5	1.4	1.7	1.8	2.9	3.4	1.9	2.6
TOTAL[1]	**626.8**	**570.9**	**589.1**	**636.9**	**688.1**	**710.6**	**635.2**	**688.1**	**610.2**	**597.4**	**614.8**	**..**

1. Yearly totals are not comparable due to missing data (see Table B11).

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B13

IEA Government R&D Budgets for Electricity
(US$ million at 1999 prices and exchange rates)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	4.4	4.1	3.5	3.0	8.2	8.9	8.3	8.1	6.9	3.8	4.1	3.8
United States	66.3	61.0	64.8	63.5	45.5	46.8	125.9	139.8	126.2	128.8	128.0	129.5
Australia	..	8.9	..	..	..	5.7	..	4.6	..	4.3	..	..
Japan	87.7	94.4	100.8	101.9	103.7	63.9	73.0	73.2	76.8	79.1	135.7	131.7
New Zealand	..	..	–	–	..	–	–	0.1	0.2	0.2	0.2	0.6
Austria	6.9	4.9	3.0	5.7	3.5	3.7	4.8	4.0	4.6	4.0	4.5	..
Belgium[1]	2.1	1.5	..	0.1	2.6	7.5	4.2	5.7	5.7	1.8	4.9	..
Luxembourg[2]	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	..	3.1	5.0	4.1	4.8	5.6	4.1	3.9	4.3	4.3	4.4	4.0
Finland	..	..	11.9	11.7	13.7	11.8	16.5	16.8	12.5	16.2	14.9	..
France	–	–	–	–	–	–	–	–	–	–	–	–
Germany[3]	7.1	8.9	9.4	6.5	4.9	2.7	3.2	2.2	12.6	21.8	23.1	26.5
Greece	0.8	0.7	0.5	0.9	0.1	–	0.1	0.1	0.1	0.2	..	..
Hungary	..	..	..	..	..	..	..	–	–	..	0.1	–
Ireland	0.3	..	–	..	..	..	..	..	..	..	..	..
Italy	96.4	102.0	31.3	54.6	..	11.5	20.0	15.9	16.3	15.0	15.6	..
Netherlands	4.7	1.8	1.8	1.7	20.3	33.2	35.8	17.4	17.2	15.5	14.6	..
Norway	1.4	3.9	4.9	0.7	2.8	2.8	2.8	3.5	2.6	2.3	2.1	1.8
Portugal	0.1	0.2	0.1	–	–	–	–	–	–	–	–	–
Spain	–	–	–	–	–	–	–	0.3	0.3	0.3	0.4	0.4
Sweden	2.4	2.0	1.8	2.7	2.0	3.8	9.3	4.4	1.1	10.7	7.6	..
Switzerland	15.6	18.4	21.1	20.5	24.7	20.7	18.0	18.1	19.3	15.1	..	..
Turkey	0.4	0.3	0.1	–	–	0.1	0.1	–	–	0.1	0.1	0.2
United Kingdom	3.6	–	1.7	2.2	3.1	–	6.9	5.5	1.9	1.9	2.0	2.6
Total Reported[4]	**300.3**	**315.9**	**261.6**	**279.8**	**239.8**	**228.6**	**332.8**	**323.6**	**308.5**	**325.6**	**362.0**	**..**

1. Figures for 1991 refer to Wallonia only.
2. Luxembourg has no energy R&D programme.
3. Data do not include the new Laender of Germany prior to 1992.
4. Yearly totals are not comparable due to missing data.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B13A

IEA Government R&D Budgets for Energy Systems Analysis & Others

(US$ million at 1999 prices and exchange rates)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	5.0	14.5	9.6	9.6	16.7	6.2	7.5	7.3	11.4	13.2	10.0	10.7
United States	503.4	623.8	532.6	661.3	882.9	947.7	832.9	789.7	822.6	835.6	828.6	976.2
Australia	..	1.5	..	..	..	11.0	..	15.1	..	11.8	..	..
Japan	26.0	22.5	22.9	95.7	113.0	101.0	119.7	124.7	125.4	128.7	113.4	86.1
New Zealand	..	..	–	–	..	–	0.2	0.1	0.1	–	0.6	–
Austria	2.8	1.1	0.7	1.1	1.5	2.3	1.3	1.8	2.2	3.0	3.9	..
Belgium[1]	0.6	–	..	2.1	2.3	1.3	1.9	2.0	1.2	1.5	1.1	..
Luxembourg[2]	–	–	–	–	–	–	–	–	–	–	–	–
Denmark	..	1.8	1.7	3.8	4.3	4.6	4.1	5.5	5.8	5.7	6.9	7.0
Finland	..	..	3.1	2.8	2.7	2.8	6.5	9.8	8.4	7.5	4.6	..
France	–	–	–	–	–	–	–	–	–	–	–	–
Germany[3]	0.1	1.5	2.1	1.9	5.6	19.0	20.0	6.4	11.6	9.7	8.6	10.5
Greece	0.4	0.5	1.1	1.8	1.0	1.4	0.6	1.3	2.2	1.1	..	..
Hungary	..	..	..	..	..	..	..	–	–	..	0.2	–
Ireland	0.3	..	0.2	..	..	..	..	..	..	..	..	..
Italy	266.1	305.9	290.1	271.8	..	68.2	59.8	68.3	46.3	32.5	35.0	..
Netherlands	26.9	27.9	32.6	31.7	9.8	9.4	7.5	13.0	12.8	15.8	17.0	..
Norway	2.2	8.3	7.7	9.7	7.2	7.1	4.6	4.7	5.1	4.7	3.9	3.7
Portugal	1.9	1.8	2.0	1.4	0.1	–	–	–	–	–	0.2	0.2
Spain	21.0	15.4	–	20.7	20.3	19.1	18.3	13.1	12.8	13.2	2.0	0.4
Sweden	22.7	19.6	18.9	19.3	20.1	15.6	12.6	11.4	11.4	14.6	11.6	..
Switzerland	8.6	10.0	8.4	8.7	10.6	10.4	11.8	11.6	10.5	10.4	..	..
Turkey	–	–	–	–	0.2	0.2	0.1	0.3	0.2	0.2	0.1	0.1
United Kingdom	47.7	6.8	8.5	9.3	6.9	1.1	8.9	9.2	7.1	30.6	31.2	32.0
Total Reported[4]	**935.8**	**1 062.8**	**942.2**	**1 152.9**	**1 105.3**	**1 228.4**	**1 118.0**	**1 095.4**	**1 097.0**	**1 139.8**	**1 079.0**	**..**

1. Figures for 1991 refer to Wallonia only.
2. Luxembourg has no energy R&D programme.
3. Data do not include the new Laender of Germany prior to 1992.
4. Yearly totals are not comparable due to missing data.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Table B14

IEA Government Energy R&D Expenditure by Country, 1998 and 1999

(US$ million at 1999 prices and exchange rates)

	Australia[1]				Austria[2]			
	1998		1999		1998		1999	
	$	%	$	%	$	%	$	%
1.1 Industry	..	..	..	..	0.62	2.11	..	..
1.2 Residential. Commercial	..	..	..	..	3.35	11.35	..	..
1.3 Transportation	..	..	..	..	3.14	10.66	..	..
1.4 Other Conservation	..	..	..	..	0.25	0.86	..	..
TOTAL CONSERVATION	..	..	..	..	**7.36**	**24.98**	..	..
2.1 Enhanced Oil & Gas	..	..	..	..	–	–	..	..
2.2 Refining. Transp. & Stor.	..	..	..	..	–	–	..	..
2.3 Oil Shale & Tar Sands	..	..	..	..	–	–	..	..
2.4 Other Oil & Gas	..	..	..	..	0.26	0.89	..	..
Total Oil & Gas	..	..	..	..	0.26	0.89	..	..
3.1 Coal Prod.. Prep.. & Trans.	..	..	..	..	–	–	..	..
3.2 Coal Combustion	..	..	..	..	0.31	1.04	..	..
3.3 Coal Conversion	..	..	..	..	0.04	0.15	..	..
3.4 Other Coal	..	..	..	..	0.02	0.08	..	..
Total Coal	..	..	..	..	0.37	1.26	..	..
TOTAL FOSSIL FUELS	..	..	..	..	**0.63**	**2.15**	..	..
4.1 Solar Heating & Cooling	..	..	..	..	1.73	5.87	..	..
4.2 Solar Photo–Electric	..	..	..	..	1.95	6.63	..	..
4.3 Solar Thermal–Electric	..	..	..	..	0.14	0.48	..	..
Total Solar	..	..	..	..	3.82	12.97	..	..
5. Wind	..	..	..	..	0.61	2.07	..	..
6. Ocean	..	..	..	..	–	–	..	..
7. Biomass	..	..	..	..	4.89	16.60	..	..
8. Geothermal	..	..	..	..	0.43	1.46	..	..
9.1 Large Hydro (>10 MW)	..	..	..	..	0.48	1.62	..	..
9.2 Small Hydro (<10 MW)	..	..	..	..	0.34	1.14	..	..
Total Hydro	..	..	..	..	0.82	2.77	..	..
TOTAL RENEWABLE ENERGY	..	..	..	..	**10.57**	**35.87**	..	..
10.1 Nuclear LWR	..	..	..	..	–	–	..	..
10.2 Other Converter Reactors	..	..	..	..	–	–	..	..
10.3 Nuclear Fuel Cycle	..	..	..	..	–	–	..	..
10.4 Nuclear Supporting Tech.	..	..	..	..	–	–	..	..
10.5 Nuclear Breeder	..	..	..	..	–	–	..	..
Total Nuclear Fission	..	..	..	..	–	–	..	..
11. Nuclear Fusion	..	..	..	..	2.56	8.68	..	..
TOTAL NUCLEAR	..	..	..	..	**2.56**	**8.68**	..	..
12.1 Electric Power Conversion	..	..	..	..	1.15	3.89	..	..
12.2 Electricity Transm.. & Distr.	..	..	..	..	2.22	7.53	..	..
12.3 Energy Storage	..	..	..	..	1.12	3.81	..	..
TOTAL POWER & STORAGE	..	..	..	..	**4.49**	**15.22**	..	..
13.1 Energy Systems Analysis	..	..	..	..	1.41	4.77	..	..
13.2 Other Tech. or Research	..	..	..	..	2.45	8.32	..	..
TOTAL OTHER TECH./RESEARCH	..	..	..	..	**3.86**	**13.09**	..	..
TOTAL ENERGY R&D	..	..	..	..	**29.48**	**100.00**	..	..

1. Australia has not provided data for 1998 and 1999.
2. Austria has not provided data for 1999.
3. For 1999, Belgium has only provided data on nuclear R&D.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

	Belgium[3]				Canada				Denmark			
	1998		1999		1998		1999		1998		1999	
	$	%	$	%	$	%	$	%	$	%	$	%
	5.49	7.25	..	..	10.13	5.95	12.06	7.22	6.59	14.23	6.28	14.01
	2.77	3.66	..	..	9.35	5.49	8.96	5.36	1.14	2.47	1.81	4.03
	5.31	7.01	..	..	14.59	8.57	13.11	7.85	0.18	0.38	1.38	3.07
	0.74	0.98	..	..	2.87	1.68	3.85	2.30	0.92	1.99	0.37	0.83
	14.31	**18.88**	**..**	**..**	**36.94**	**21.69**	**37.98**	**22.72**	**8.84**	**19.07**	**9.83**	**21.94**
	–	–	..	..	1.48	0.87	1.45	0.87	1.49	3.23	1.73	3.87
	–	–	..	..	4.99	2.93	6.36	3.80	..	..	0.59	1.31
	–	–	..	..	23.46	13.77	19.14	11.45	..	..	..	..
	–	–	..	..	6.54	3.84	6.97	4.17	0.56	1.20	0.21	0.48
	–	–	..	..	36.47	21.41	33.92	20.29	2.05	4.43	2.54	5.66
	0.04	0.05	..	..	0.75	0.44	0.76	0.46	..	..	..	..
	0.26	0.34	..	..	0.54	0.32	0.53	0.32	0.04	0.09	0.04	0.10
	0.04	0.05	..	..	1.38	0.81	1.36	0.81	..	..	..	..
	0.13	0.17	..	..	1.24	0.73	1.23	0.73	..	..	..	..
	0.47	0.61	..	..	3.91	2.30	3.88	2.32	0.04	0.09	0.04	0.10
	0.47	**0.61**	**..**	**..**	**40.38**	**23.71**	**37.80**	**22.61**	**2.10**	**4.52**	**2.58**	**5.76**
	0.21	0.28	..	..	0.84	0.50	1.05	0.63	3.02	6.51	2.75	6.14
	0.24	0.32	..	..	1.29	0.76	1.71	1.03	0.76	1.64	0.60	1.34
	0.03	0.04	..	..	0.08	0.05	0.07	0.04	..	..	..	..
	0.48	0.63	..	..	2.22	1.30	2.84	1.70	3.78	8.16	3.35	7.49
	0.27	0.35	..	..	0.86	0.50	0.75	0.45	7.58	16.35	7.22	16.12
	–	–	..	..	0.09	0.05	0.07	0.04	0.88	1.90	1.15	2.56
	0.54	0.71	..	..	4.03	2.36	4.32	2.59	5.25	11.32	4.94	11.04
	–	–	..	..	0.07	0.04	0.07	0.04	1.88	4.05	..	..
	–	–	..	..	0.07	0.04	0.07	0.04	..	..	..	..
	0.07	0.09	..	..	1.09	0.64	1.16	0.70	..	..	..	..
	0.07	0.09	..	..	1.16	0.68	1.23	0.74	..	..	..	..
	1.35	**1.79**	**..**	**..**	**8.42**	**4.94**	**9.29**	**5.56**	**19.36**	**41.78**	**16.66**	**37.20**
	33.13	43.71	24.05	..	0.17	0.10	0.17	0.10	..	..	..	..
	–	–	..	..	61.27	35.97	60.29	36.07	..	..	..	..
	4.16	5.49	2.93	..	5.43	3.19	5.48	3.28	..	..	..	..
	11.17	14.74	10.40	..	1.07	0.63	1.32	0.79	2.93	6.33	2.87	6.40
	–	–	..	..	0.17	0.10	0.17	0.10	..	..	..	..
	48.46	63.93	37.38	..	68.11	39.98	67.42	40.34	2.93	6.33	2.87	6.40
	5.29	6.98	5.90	..	2.37	1.39	0.17	0.10	1.85	3.98	1.86	4.16
	53.75	**70.92**	**43.29**	**..**	**70.47**	**41.37**	**67.59**	**40.44**	**4.78**	**10.31**	**4.73**	**10.56**
	1.96	2.58	..	..	1.23	0.72	1.04	0.62	3.63	7.84	3.24	7.23
	2.81	3.71	..	..	1.26	0.74	0.95	0.57	..	..	..	..
	0.08	0.11	..	..	1.66	0.97	1.77	1.06	0.72	1.55	0.73	1.63
	4.85	**6.40**	**..**	**..**	**4.14**	**2.43**	**3.76**	**2.25**	**4.35**	**9.39**	**3.97**	**8.86**
	0.37	0.48	..	..	0.48	0.28	0.44	0.26	3.94	8.51	3.81	8.51
	0.69	0.91	..	..	9.51	5.58	10.29	6.16	2.97	6.42	3.21	7.17
	1.06	**1.40**	**..**	**..**	**9.98**	**5.86**	**10.74**	**6.42**	**6.92**	**14.93**	**7.02**	**15.67**
	75.80	**100.00**	**..**	**..**	**170.34**	**100.00**	**167.15**	**100.00**	**46.33**	**100.00**	**44.79**	**100.00**

Table B14 (continued)

IEA Government Energy R&D Expenditure by Country, 1998 and 1999

(US$ million at 1999 prices and exchange rates)

	Finland[1]				France			
	1998		1999		1998		1999	
	$	%	$	%	$	%	$	%
1.1 Industry	22.10	25.12	..	..	1.88	0.33	3.57	0.54
1.2 Residential. Commercial	15.29	17.38	..	..	1.98	0.35	3.74	0.57
1.3 Transportation	2.90	3.29	..	..	2.47	0.44	4.87	0.74
1.4 Other Conservation	5.36	6.09	..	..	0.16	0.03	0.16	0.02
TOTAL CONSERVATION	**45.65**	**51.89**	**..**	**..**	**6.49**	**1.15**	**12.35**	**1.88**
2.1 Enhanced Oil & Gas	–	–	..	..	10.79	1.91	10.72	1.63
2.2 Refining. Transp. & Stor.	2.49	2.83	..	..	–	–	–	–
2.3 Oil Shale & Tar Sands	–	–	..	..	–	–	–	–
2.4 Other Oil & Gas	–	–	..	..	20.12	3.56	19.98	3.04
Total Oil & Gas	2.49	2.83	..	..	30.91	5.47	30.70	4.67
3.1 Coal Prod.. Prep.. & Trans.	0.05	0.06	..	..	0.10	0.02	–	–
3.2 Coal Combustion	0.63	0.71	..	..	–	–	–	–
3.3 Coal Conversion	..	..	..	..	–	–	–	–
3.4 Other Coal	2.32	2.64	..	..	–	–	–	–
Total Coal	3.00	3.41	..	..	0.10	0.02	–	–
TOTAL FOSSIL FUELS	**5.49**	**6.24**	**..**	**..**	**31.01**	**5.48**	**30.70**	**4.67**
4.1 Solar Heating & Cooling	0.70	0.80	..	..	0.16	0.03	1.46	0.22
4.2 Solar Photo–Electric	–	–	..	..	1.42	0.25	3.25	0.49
4.3 Solar Thermal–Electric	–	–	..	..	–	–	–	–
Total Solar	0.70	0.80	..	..	1.59	0.28	4.71	0.72
5. Wind	0.97	1.10	..	..	0.41	0.07	2.44	0.37
6. Ocean	–	–	..	..	–	–	–	–
7. Biomass	6.32	7.18	..	..	1.67	0.30	4.22	0.64
8. Geothermal	–	–	..	..	0.38	0.07	1.30	0.20
9.1 Large Hydro (>10 MW)	0.79	0.90	..	..	–	–	–	–
9.2 Small Hydro (<10 MW)	–	–	..	..	0.05	0.01	0.65	0.10
Total Hydro	0.79	0.90	..	..	0.05	0.01	0.65	0.10
TOTAL RENEWABLE ENERGY	**8.78**	**9.98**	**..**	**..**	**4.09**	**0.72**	**13.32**	**2.03**
10.1 Nuclear LWR	5.13	5.83	..	..	113.17	20.02	102.18	15.54
10.2 Other Converter Reactors	–	–	..	..	3.43	0.61	3.90	0.59
10.3 Nuclear Fuel Cycle	1.92	2.18	..	..	224.87	39.77	281.68	42.84
10.4 Nuclear Supporting Tech.	0.44	0.50	..	..	128.05	22.65	161.14	24.51
10.5 Nuclear Breeder	–	–	..	..	22.08	3.90	20.31	3.09
Total Nuclear Fission	7.48	8.51	..	..	491.60	86.95	569.20	86.56
11. Nuclear Fusion	1.06	1.21	..	..	32.22	5.70	32.00	4.87
TOTAL NUCLEAR	**8.55**	**9.72**	**..**	**..**	**523.81**	**92.64**	**601.20**	**91.43**
12.1 Electric Power Conversion	11.01	12.51	..	..	–	–	–	–
12.2 Electricity Transm.. & Distr.	3.47	3.95	..	..	–	–	–	–
12.3 Energy Storage	0.38	0.43	..	..	–	–	–	–
TOTAL POWER & STORAGE	**14.86**	**16.90**	**..**	**..**	**–**	**–**	**–**	**–**
13.1 Energy Systems Analysis	4.35	4.94	..	..	–	–	–	–
13.2 Other Tech. or Research	0.29	0.33	..	..	–	–	–	–
TOTAL OTHER TECH./RESEARCH	**4.64**	**5.28**	**..**	**..**	**–**	**–**	**–**	**–**
TOTAL ENERGY R&D	**87.98**	**100.00**	**..**	**..**	**565.40**	**100.00**	**657.57**	**100.00**

1. Finland has not provided data for 1999. Coal production, preparation and transport includes coal conversion. Other coal
2. Greece has not provided data for 1998 and 1999.
3. Hungary has not provided complete data for 1999.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Germany				Greece[2]				Hungary[3]			
1998 $	%	1999 $	%	1998 $	%	1999 $	%	1998 $	%	1999 $	%
5.57	1.84	4.63	1.61	..	..	..	..	0.01	1.56	..	..
5.02	1.66	5.12	1.78	..	..	..	..	–	–	..	..
–	–	–	–	..	..	..	..	–	–	..	..
2.92	0.97	1.96	0.68	..	..	..	..	–	–	..	..
13.51	**4.47**	**11.72**	**4.08**	**..**	**..**	**..**	**..**	**0.01**	**1.56**	**..**	**..**
–	–	–	–	..	..	..	..	–	–	..	..
–	–	–	–	..	..	..	..	–	–	..	..
–	–	–	–	..	..	..	..	–	–	..	..
–	–	–	–	..	..	..	..	0.00	0.25	..	..
–	–	–	–	..	..	..	..	0.00	0.25	..	..
0.22	0.07	–	–	..	..	..	..	–	–	..	..
1.10	0.37	0.82	0.28	..	..	..	..	–	–	..	..
–	–	–	–	..	..	..	..	–	–	..	..
–	–	–	–	..	..	..	..	–	–	..	..
1.32	0.44	0.82	0.28	..	..	..	..	–	–	..	..
1.32	**0.44**	**0.82**	**0.28**	**..**	**..**	**..**	**..**	**0.00**	**0.25**	**..**	**..**
11.03	3.65	11.12	3.87	..	..	..	..	0.02	4.10	..	..
37.16	12.30	28.72	10.00	..	..	..	..	–	–	..	..
6.73	2.23	6.92	2.41	..	..	..	..	–	–	..	..
54.91	18.18	46.76	16.28	..	..	..	..	0.02	4.10	..	..
21.78	7.21	19.24	6.70	..	..	..	..	–	–	..	..
–	–	–	–	..	..	..	..	–	–	..	..
6.62	2.19	5.45	1.90	..	..	..	..	–	–	..	..
1.82	0.60	1.63	0.57	..	..	..	..	–	–	..	..
–	–	–	–	..	..	..	..	–	–	..	..
–	–	–	–	..	..	..	..	–	–	..	..
–	–	–	–	..	..	..	..	–	–	..	..
85.12	**28.19**	**73.08**	**25.44**	**..**	**..**	**..**	**..**	**0.02**	**4.10**	**..**	**..**
25.86	8.56	21.25	7.40	..	..	..	..	0.08	14.35	0.19	61.25
–	–	–	–	..	..	..	..	–	–	–	–
12.74	4.22	9.26	3.23	..	..	..	..	–	–	–	–
–	–	–	–	..	..	..	..	0.09	16.40	0.11	35.29
–	–	–	–	..	..	..	..	–	–	–	–
38.59	12.78	30.52	10.62	..	..	..	..	0.17	30.75	0.31	96.54
131.76	43.63	134.11	46.69	..	..	..	..	–	–	–	–
170.36	**56.41**	**164.63**	**57.31**	**..**	**..**	**..**	**..**	**0.17**	**30.75**	**0.31**	**96.54**
22.71	7.52	26.10	9.09	..	..	..	..	0.07	12.45	–	–
–	–	0.16	0.06	..	..	..	..	0.07	12.87	0.01	1.60
0.39	0.13	0.27	0.09	..	..	..	..	–	–	0.01	1.86
23.10	**7.65**	**26.54**	**9.24**	**..**	**..**	**..**	**..**	**0.14**	**25.33**	**0.01**	**3.46**
1.65	0.55	1.53	0.53	..	..	..	..	–	–	–	–
6.95	2.30	8.94	3.11	..	..	..	..	0.22	38.02	–	–
8.60	**2.85**	**10.46**	**3.64**	**..**	**..**	**..**	**..**	**0.22**	**38.02**	**–**	**–**
302.01	**100.00**	**287.25**	**100.00**	**..**	**..**	**..**	**..**	**0.57**	**100.00**	**0.32**	**100.00**

refers to peat.

Table B14 (continued)

IEA Government Energy R&D Expenditure by Country, 1998 and 1999

(US$ million at 1999 prices and exchange rates)

	Ireland[1]				Italy[2]			
	1998 $	%	1999 $	%	1998 $	%	1999 $	%
1.1 Industry	..	..	..	..	15.65	6.51	..	..
1.2 Residential. Commercial	..	..	..	..	12.29	5.12	..	..
1.3 Transportation	..	..	..	..	14.81	6.16	..	..
1.4 Other Conservation	..	..	..	..	7.82	3.26	..	..
TOTAL CONSERVATION	**..**	**..**	**..**	**..**	**50.57**	**21.05**	**..**	**..**
2.1 Enhanced Oil & Gas	..	..	..	..	–	–	..	..
2.2 Refining. Transp. & Stor.	..	..	..	..	–	–	..	..
2.3 Oil Shale & Tar Sands	..	..	..	..	–	–	..	..
2.4 Other Oil & Gas	..	..	..	..	–	–	..	..
Total Oil & Gas	..	..	..	..	–	–	..	..
3.1 Coal Prod.. Prep.. & Trans.	..	..	..	..	–	–	..	..
3.2 Coal Combustion	..	..	..	..	–	–	..	..
3.3 Coal Conversion	..	..	..	..	–	–	..	..
3.4 Other Coal	..	..	..	..	–	–	..	..
Total Coal	..	..	..	..	–	–	..	..
TOTAL FOSSIL FUELS	**..**	**..**	**..**	**..**	**–**	**–**	**..**	**..**
4.1 Solar Heating & Cooling	..	..	..	..	–	–	..	..
4.2 Solar Photo–Electric	..	..	..	..	19.56	8.14	..	..
4.3 Solar Thermal–Electric	..	..	..	..	–	–	..	..
Total Solar	..	..	..	..	19.56	8.14	..	..
5. Wind	..	..	..	..	5.87	2.44	..	..
6. Ocean	..	..	..	..	–	–	..	..
7. Biomass	..	..	..	..	8.55	3.56	..	..
8. Geothermal	..	..	..	..	–	–	..	..
9.1 Large Hydro (>10 MW)	..	..	..	..	–	–	..	..
9.2 Small Hydro (<10 MW)	..	..	..	..	–	–	..	..
Total Hydro	..	..	..	..	–	–	..	..
TOTAL RENEWABLE ENERGY	**..**	**..**	**..**	**..**	**33.97**	**14.14**	**..**	**..**
10.1 Nuclear LWR	..	..	..	..	8.38	3.49	..	..
10.2 Other Converter Reactors	..	..	..	..	–	–	..	..
10.3 Nuclear Fuel Cycle	..	..	..	..	16.76	6.98	..	..
10.4 Nuclear Supporting Tech.	..	..	..	..	8.38	3.49	..	..
10.5 Nuclear Breeder	..	..	..	..	–	–	..	..
Total Nuclear Fission	..	..	..	..	33.53	13.95	..	..
11. Nuclear Fusion	..	..	..	..	71.52	29.77	..	..
TOTAL NUCLEAR	**..**	**..**	**..**	**..**	**105.05**	**43.72**	**..**	**..**
12.1 Electric Power Conversion	..	..	..	..	11.18	4.65	..	..
12.2 Electricity Transm.. & Distr.	..	..	..	..	–	–	..	..
12.3 Energy Storage	..	..	..	..	4.47	1.86	..	..
TOTAL POWER & STORAGE	**..**	**..**	**..**	**..**	**15.65**	**6.51**	**..**	**..**
13.1 Energy Systems Analysis	..	..	..	..	10.06	4.19	..	..
13.2 Other Tech. or Research	..	..	..	..	24.98	10.40	..	..
TOTAL OTHER TECH./RESEARCH	**..**	**..**	**..**	**..**	**35.03**	**14.58**	**..**	**..**
TOTAL ENERGY R&D	**..**	**..**	**..**	**..**	**240.27**	**100.00**	**..**	**..**

1. Ireland has not provided data for 1998 and 1999.
2. Italy has not provided data for 1999.
3. Luxembourg has no energy R&D programme.
4. The Netherlands has not provided data for 1999.

Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

Japan				Luxembourg[3]				Netherlands[4]			
1998		1999		1998		1999		1998		1999	
$	%	$	%	$	%	$	%	$	%	$	%
385.56	10.01	455.07	11.84	–	–	–	–	29.01	21.72	..	..
38.82	1.01	46.55	1.21	–	–	–	–	7.17	5.37	..	..
15.84	0.41	32.66	0.85	–	–	–	–	9.29	6.96	..	..
27.08	0.70	30.50	0.79	–	–	–	–	3.21	2.41	..	..
467.30	**12.13**	**564.78**	**14.69**	**–**	**–**	**–**	**–**	**48.67**	**36.45**	**..**	**..**
27.36	0.71	25.29	0.66	–	–	–	–	3.56	2.66	..	..
70.31	1.82	46.79	1.22	–	–	–	–	2.72	2.04	..	..
–	–	–	–	–	–	–	–	–	–	..	..
6.58	0.17	6.83	0.18	–	–	–	–	2.17	1.63	..	..
104.25	2.71	78.91	2.05	–	–	–	–	8.45	6.33	..	..
16.08	0.42	11.91	0.31	–	–	–	–	–	–	..	..
55.71	1.45	38.08	0.99	–	–	–	–	0.35	0.26	..	..
105.93	2.75	84.79	2.21	–	–	–	–	1.78	1.33	..	..
0.24	0.01	1.32	0.03	–	–	–	–	1.14	0.85	..	..
177.96	4.62	136.10	3.54	–	–	–	–	3.26	2.44	..	..
282.22	**7.32**	**215.01**	**5.59**	**–**	**–**	**–**	**–**	**11.71**	**8.77**	**..**	**..**
1.51	0.04	0.54	0.01	–	–	–	–	1.04	0.78	..	..
78.09	2.03	89.49	2.33	–	–	–	–	10.43	7.81	..	..
–	–	–	–	–	–	–	–	–	–	..	..
79.60	2.07	90.03	2.34	–	–	–	–	11.46	8.59	..	..
4.18	0.11	3.65	0.10	–	–	–	–	6.47	4.85	..	..
9.95	0.26	1.09	0.03	–	–	–	–	–	–	..	..
5.06	0.13	4.93	0.13	–	–	–	–	3.80	2.85	..	..
28.47	0.74	28.60	0.74	–	–	–	–	0.05	0.04	..	..
–	–	–	–	–	–	–	–	0.05	0.04	..	..
–	–	–	–	–	–	–	–	–	–	..	..
–	–	–	–	–	–	–	–	0.05	0.04	..	..
127.26	**3.30**	**128.30**	**3.34**	**–**	**–**	**–**	**–**	**21.84**	**16.36**	**..**	**..**
163.10	4.23	147.32	3.83	–	–	–	–	6.18	4.63	..	..
57.00	1.48	60.52	1.57	–	–	–	–	0.64	0.48	..	..
883.51	22.93	968.31	25.19	–	–	–	–	3.56	2.66	..	..
1 112.96	28.89	1 057.89	27.52	–	–	–	–	2.62	1.96	..	..
245.33	6.37	225.17	5.86	–	–	–	–	–	–	..	..
2 461.90	63.90	2 459.22	63.97	–	–	–	–	13.00	9.73	..	..
265.17	6.88	259.26	6.74	–	–	–	–	6.67	5.00	..	..
2 727.07	**70.78**	**2 718.48**	**70.71**	**–**	**–**	**–**	**–**	**19.67**	**14.73**	**..**	**..**
78.26	2.03	52.46	1.36	–	–	–	–	10.92	8.18	..	..
25.94	0.67	44.22	1.15	–	–	–	–	3.41	2.55	..	..
31.48	0.82	35.06	0.91	–	–	–	–	0.25	0.19	..	..
135.69	**3.52**	**131.74**	**3.43**	**–**	**–**	**–**	**–**	**14.58**	**10.92**	**..**	**..**
0.51	0.01	1.55	0.04	–	–	–	–	6.57	4.92	..	..
112.93	2.93	84.56	2.20	–	–	–	–	10.48	7.85	..	..
113.44	**2.94**	**86.11**	**2.24**	**–**	**–**	**–**	**–**	**17.05**	**12.77**	**..**	**..**
3 852.96	**100.00**	**3 844.42**	**100.00**	**–**	**–**	**–**	**–**	**133.52**	**100.00**	**..**	**..**

Table B14 (continued)

IEA Government Energy R&D Expenditure by Country, 1998 and 1999
(US$ million at 1999 prices and exchange rates)

	New Zealand				Norway			
	1998		1999		1998		1999	
	$	%	$	%	$	%	$	%
1.1 Industry	–	–	–	–	0.31	0.83	0.38	0.81
1.2 Residential. Commercial	0.09	2.64	0.14	4.41	1.16	3.06	1.03	2.15
1.3 Transportation	–	–	–	–	–	–	–	–
1.4 Other Conservation	0.15	4.34	0.35	10.96	–	–	–	–
TOTAL CONSERVATION	**0.24**	**6.98**	**0.50**	**15.38**	**1.47**	**3.89**	**1.41**	**2.96**
2.1 Enhanced Oil & Gas	0.61	17.86	0.57	17.65	5.89	15.61	7.28	15.26
2.2 Refining. Transp. & Stor.	–	–	–	–	1.36	3.60	2.36	4.94
2.3 Oil Shale & Tar Sands	–	–	–	–	0.92	2.45	0.38	0.81
2.4 Other Oil & Gas	–	–	–	–	9.38	24.87	18.64	39.05
Total Oil & Gas	0.61	17.86	0.57	17.65	17.56	46.54	28.66	60.06
3.1 Coal Prod.. Prep.. & Trans.	0.09	2.51	0.08	2.61	–	–	–	–
3.2 Coal Combustion	0.20	5.80	0.26	7.92	–	–	–	–
3.3 Coal Conversion	–	–	–	–	–	–	–	–
3.4 Other Coal	0.08	2.36	–	–	–	–	–	–
Total Coal	0.36	10.67	0.34	10.54	–	–	–	–
TOTAL FOSSIL FUELS	**0.97**	**28.53**	**0.91**	**28.19**	**17.56**	**46.54**	**28.66**	**60.06**
4.1 Solar Heating & Cooling	–	–	–	–	0.61	1.62	0.64	1.34
4.2 Solar Photo–Electric	0.09	2.59	0.16	4.90	0.42	1.12	0.54	1.13
4.3 Solar Thermal–Electric	0.09	2.59	–	–	–	–	–	–
Total Solar	0.18	5.19	0.16	4.90	1.03	2.74	1.18	2.47
5. Wind	0.12	3.52	0.10	3.10	0.33	0.87	0.44	0.91
6. Ocean	–	–	–	–	0.48	1.26	0.45	0.94
7. Biomass	0.15	4.34	0.22	6.93	0.83	2.20	0.85	1.77
8. Geothermal	0.97	28.45	0.64	19.77	0.18	0.47	–	–
9.1 Large Hydro (>10 MW)	–	–	0.12	3.64	2.00	5.30	1.89	3.95
9.2 Small Hydro (<10 MW)	–	–	–	–	–	–	–	–
Total Hydro	–	–	0.12	3.64	2.00	5.30	1.89	3.95
TOTAL RENEWABLE ENERGY	**1.42**	**41.50**	**1.24**	**38.35**	**4.84**	**12.83**	**4.80**	**10.05**
10.1 Nuclear LWR	–	–	–	–	–	–	–	–
10.2 Other Converter Reactors	–	–	–	–	–	–	–	–
10.3 Nuclear Fuel Cycle	–	–	–	–	2.04	5.41	1.92	4.03
10.4 Nuclear Supporting Tech.	–	–	–	–	5.85	15.50	5.51	11.56
10.5 Nuclear Breeder	–	–	–	–	–	–	–	–
Total Nuclear Fission	–	–	–	–	7.89	20.91	7.44	15.59
11. Nuclear Fusion	–	–	–	–	–	–	–	–
TOTAL NUCLEAR	**–**	**–**	**–**	**–**	**7.89**	**20.91**	**7.44**	**15.59**
12.1 Electric Power Conversion	0.07	1.98	0.59	18.09	–	–	–	–
12.2 Electricity Transm.. & Distr.	–	–	–	–	2.07	5.48	1.76	3.68
12.3 Energy Storage	0.12	3.46	–	–	–	–	–	–
TOTAL POWER & STORAGE	**0.19**	**5.44**	**0.59**	**18.09**	**2.07**	**5.48**	**1.76**	**3.68**
13.1 Energy Systems Analysis	–	–	–	–	1.43	3.79	1.39	2.90
13.2 Other Tech. or Research	0.60	17.56	–	–	2.48	6.56	2.27	4.76
TOTAL OTHER TECH./RESEARCH	**0.60**	**17.56**	**–**	**–**	**3.90**	**10.35**	**3.66**	**7.66**
TOTAL ENERGY R&D	**3.41**	**100.00**	**3.23**	**100.00**	**37.72**	**100.00**	**47.72**	**100.00**

1. Sweden has not provided data for 1999.
Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

	Portugal				Spain				Sweden[1]			
	1998		1999		1998		1999		1998		1999	
	$	%	$	%	$	%	$	%	$	%	$	%
	0.11	6.03	0.19	8.92	4.09	7.91	6.32	11.43	4.16	7.76	..	..
	–	–	–	–	2.08	4.04	5.20	9.41	4.02	7.50	..	..
	–	–	–	–	0.61	1.18	1.69	3.06	3.77	7.04	..	..
	–	–	–	–	–	–	–	–	3.11	5.81	..	..
	0.11	**6.03**	**0.19**	**8.92**	**6.78**	**13.12**	**13.21**	**23.90**	**15.07**	**28.10**	**..**	**..**
	0.06	3.34	0.12	5.86	–	–	–	–	–	–	..	..
	–	–	–	–	–	–	–	–	–	–	..	..
	–	–	–	–	–	–	–	–	–	–	..	..
	–	–	–	–	–	–	0.09	0.16	–	–	..	..
	0.06	3.34	0.12	5.86	–	–	0.09	0.16	–	–	..	..
	–	–	–	–	0.64	1.24	–	–	–	–	..	..
	0.14	7.93	0.23	10.83	1.50	2.89	0.76	1.38	–	–	..	..
	–	–	–	–	0.48	0.93	–	–	–	–	..	..
	–	–	–	–	–	–	–	–	0.05	0.09	..	..
	0.14	7.93	0.23	10.83	2.61	5.06	0.76	1.38	0.05	0.09	..	..
	0.20	**11.27**	**0.35**	**16.69**	**2.61**	**5.06**	**0.85**	**1.54**	**0.05**	**0.09**	**..**	**..**
	0.36	20.36	0.31	14.66	0.37	0.71	0.27	0.49	1.95	3.64	..	..
	0.03	1.45	0.02	0.92	1.44	2.79	1.54	2.79	0.70	1.30	..	..
	–	–	–	–	1.59	3.08	1.37	2.48	–	–	..	..
	0.38	21.82	0.33	15.58	3.40	6.57	3.18	5.76	2.65	4.94	..	..
	0.01	0.79	0.04	1.76	8.62	16.68	6.47	11.72	3.92	7.32	..	..
	0.66	37.64	0.55	25.82	–	–	–	–	–	–	..	..
	0.07	4.18	0.12	5.46	5.70	11.04	9.83	17.79	6.89	12.85	..	..
	0.11	6.43	0.31	14.65	–	–	–	–	–	–	..	..
	–	–	–	–	–	–	–	–	–	–	..	..
	–	–	–	–	–	–	0.56	1.01	0.24	0.45	..	..
	–	–	–	–	–	–	0.56	1.01	0.24	0.45	..	..
	1.25	**70.85**	**1.34**	**63.29**	**17.72**	**34.29**	**20.04**	**36.27**	**13.70**	**25.56**	**..**	**..**
	–	–	–	–	–	–	–	–	–	–	..	..
	–	–	–	–	–	–	–	–	–	–	..	..
	–	–	–	–	–	–	–	–	1.06	1.98	..	..
	–	–	–	–	7.81	15.11	7.49	13.56	–	–	..	..
	–	–	–	–	–	–	–	–	3.20	5.98	..	..
	–	–	–	–	7.81	15.11	7.49	13.56	4.26	7.95	..	..
	–	–	–	–	14.42	27.91	12.81	23.19	1.36	2.54	..	..
	–	**–**	**–**	**–**	**22.23**	**43.02**	**20.31**	**36.75**	**5.63**	**10.49**	**..**	**..**
	–	–	–	–	–	–	–	–	1.33	2.47	..	..
	0.04	2.05	0.02	0.75	–	–	0.25	0.45	6.24	11.64	..	..
	–	–	–	–	0.36	0.70	0.17	0.32	–	–	..	..
	0.04	**2.05**	**0.02**	**0.75**	**0.36**	**0.70**	**0.43**	**0.77**	**7.57**	**14.11**	**..**	**..**
	0.02	1.24	0.02	0.75	–	–	–	–	0.26	0.48	..	..
	0.15	8.56	0.20	9.59	1.97	3.81	0.42	0.77	11.34	21.16	..	..
	0.17	**9.80**	**0.22**	**10.35**	**1.97**	**3.81**	**0.42**	**0.77**	**11.60**	**21.64**	**..**	**..**
	1.76	**100.00**	**2.12**	**100.00**	**51.67**	**100.00**	**55.25**	**100.00**	**53.62**	**100.00**	**..**	**..**

Table B14 (continued)

IEA Government Energy R&D Expenditure by Country, 1998 and 1999

(US$ million at 1999 prices and exchange rates)

	Switzerland[1]				Turkey			
	1998		1999		1998		1999	
	$	%	$	%	$	%	$	%
1.1 Industry	..	..	..	..	0.17	3.25	0.17	4.09
1.2 Residential. Commercial	..	..	..	..	0.04	0.67	0.02	0.58
1.3 Transportation	..	..	..	..	0.00	0.00	0.00	0.00
1.4 Other Conservation	..	..	..	..	0.00	0.00	0.00	0.00
TOTAL CONSERVATION	**..**	**..**	**..**	**..**	**0.21**	**3.92**	**0.19**	**4.67**
2.1 Enhanced Oil & Gas	..	..	..	..	0.04	0.75	0.04	0.88
2.2 Refining. Transp. & Stor.	..	..	..	..	0.46	8.65	0.24	5.84
2.3 Oil Shale & Tar Sands	..	..	..	..	–	–	–	–
2.4 Other Oil & Gas	..	..	..	..	0.28	5.32	0.32	7.87
Total Oil & Gas	..	..	..	..	0.79	14.71	0.60	14.59
3.1 Coal Prod.. Prep.. & Trans.	..	..	..	..	0.14	2.70	0.20	4.97
3.2 Coal Combustion	..	..	..	..	0.81	15.13	0.55	13.44
3.3 Coal Conversion	..	..	..	..	–	–	–	–
3.4 Other Coal	..	..	..	..	0.70	13.07	0.31	7.63
Total Coal	..	..	..	..	1.65	30.90	1.06	26.04
TOTAL FOSSIL FUELS	**..**	**..**	**..**	**..**	**2.44**	**45.61**	**1.66**	**40.62**
4.1 Solar Heating & Cooling	..	..	..	..	0.03	0.56	0.03	0.67
4.2 Solar Photo–Electric	..	..	..	..	0.17	3.24	0.04	1.04
4.3 Solar Thermal–Electric	..	..	..	..	0.02	0.29	0.01	0.26
Total Solar	..	..	..	..	0.22	4.09	0.08	1.97
5. Wind	..	..	..	..	0.06	1.06	0.04	1.05
6. Ocean	..	..	..	..	–	–	–	–
7. Biomass	..	..	..	..	0.01	0.14	0.01	0.13
8. Geothermal	..	..	..	..	1.35	25.27	0.64	15.74
9.1 Large Hydro (>10 MW)	..	..	..	..	–	–	–	–
9.2 Small Hydro (<10 MW)	..	..	..	..	–	–	–	–
Total Hydro	..	..	..	..	–	–	–	–
TOTAL RENEWABLE ENERGY	**..**	**..**	**..**	**..**	**1.63**	**30.55**	**0.77**	**18.90**
10.1 Nuclear LWR	..	..	..	..	–	–	–	–
10.2 Other Converter Reactors	..	..	..	..	0.06	1.09	0.05	1.30
10.3 Nuclear Fuel Cycle	..	..	..	..	0.38	7.03	0.26	6.31
10.4 Nuclear Supporting Tech.	..	..	..	..	0.41	7.62	0.87	21.38
10.5 Nuclear Breeder	..	..	..	..	–	–	–	–
Total Nuclear Fission	..	..	..	..	0.84	15.74	1.18	29.00
11. Nuclear Fusion	..	..	..	..	–	–	–	–
TOTAL NUCLEAR	**..**	**..**	**..**	**..**	**0.84**	**15.74**	**1.18**	**29.00**
12.1 Electric Power Conversion	..	..	..	..	0.04	0.75	0.03	0.67
12.2 Electricity Transm.. & Distr.	..	..	..	..	0.06	1.17	0.10	2.34
12.3 Energy Storage	..	..	..	..	0.02	0.36	0.07	1.75
TOTAL POWER & STORAGE	**..**	**..**	**..**	**..**	**0.12**	**2.28**	**0.19**	**4.77**
13.1 Energy Systems Analysis	..	..	..	..	–	–	–	–
13.2 Other Tech. or Research	..	..	..	..	0.10	1.90	0.08	2.04
TOTAL OTHER TECH./RESEARCH	**..**	**..**	**..**	**..**	**0.10**	**1.90**	**0.08**	**2.04**
TOTAL ENERGY R&D	**..**	**..**	**..**	**..**	**5.35**	**100.00**	**4.08**	**100.00**

1. Switzerland has not provided data for 1998 and 1999.
2. Because of missing data for Australia, Austria, Belgium, Finland, Greece, Hungary, Ireland, Italy, Netherlands, Sweden and
Sources: *OECD Economic Outlook*, OECD Paris, 1999, and country submissions.

	United Kingdom				United States				Total Reported[2]			
	1998		**1999**		**1998**		**1999**		**1998**		**1999**	
	$	%	**$**	%	**$**	%	**$**	%	**$**	%	**$**	%
	0.66	0.91	0.74	0.96	135.72	6.61	165.90	7.26	627.83	8.07	..	..
	0.15	0.21	0.15	0.19	98.73	4.81	120.00	5.25	203.44	2.61	..	..
	0.05	0.07	0.15	0.19	192.59	9.38	202.10	8.84	265.54	3.41	..	..
	–	–	–	–	–	–	–	–	54.60	0.70	..	..
	0.86	**1.19**	**1.04**	**1.34**	**427.03**	**20.81**	**488.00**	**21.35**	**151.41**	**14.79**	**..**	**..**
	3.91	5.41	3.01	3.88	50.27	2.45	52.00	2.28	105.47	1.36	..	..
	–	–	–	–	14.29	0.70	10.10	0.44	96.62	1.24	..	..
	–	–	–	–	–	–	–	–	24.39	0.31	..	..
	2.06	2.85	1.62	2.09	9.53	0.46	13.00	0.57	57.48	0.74	..	..
	5.98	8.26	4.63	5.97	74.09	3.61	75.10	3.29	283.96	3.65	..	..
	0.33	0.46	0.16	0.21	5.07	0.25	5.10	0.22	23.51	0.30	..	..
	1.14	1.57	2.38	3.07	68.93	3.36	79.10	3.46	131.64	1.69	..	..
	0.07	0.09	0.02	0.02	9.93	0.48	8.60	0.38	119.66	1.54	..	..
	0.68	0.94	0.24	0.31	21.79	1.06	29.40	1.29	28.38	0.36	..	..
	2.21	3.06	2.80	3.61	105.82	5.16	122.20	5.35	303.29	3.90	..	..
	8.19	**11.31**	**7.43**	**9.59**	**179.91**	**8.77**	**197.40**	**8.64**	**587.25**	**7.55**	**..**	**..**
	0.64	0.89	0.97	1.25	2.64	0.13	3.60	0.16	26.86	0.35	..	..
	0.97	1.35	1.62	2.09	67.91	3.31	73.40	3.21	222.64	2.86	..	..
	–	–	–	–	16.52	0.81	16.80	0.74	25.19	0.32	..	..
	1.62	2.24	2.59	3.34	87.07	4.24	93.80	4.10	274.69	3.53	..	..
	1.65	2.28	2.59	3.34	32.84	1.60	34.40	1.51	96.53	1.24	..	..
	–	–	–	–	–	–	–	–	12.05	0.15	..	..
	1.98	2.74	3.07	3.97	98.32	4.79	99.30	4.34	160.68	2.06	..	..
	–	–	–	–	29.09	1.42	28.10	1.23	64.79	0.83	..	..
	–	–	–	–	0.71	0.03	3.20	0.14	4.10	0.05	..	..
	0.13	0.18	0.24	0.31	–	–	–	–	1.92	0.02	..	..
	0.13	0.18	0.24	0.31	0.71	0.03	3.20	0.14	6.02	0.08	..	..
	5.38	**7.44**	**8.50**	**10.96**	**248.03**	**12.09**	**258.80**	**11.32**	**614.76**	**7.90**	**..**	**..**
	–	–	–	–	–	–	–	–	355.19	4.56	..	..
	–	–	–	–	–	–	–	–	122.41	1.57	..	..
	–	–	–	–	–	–	–	–	156.41	14.86	..	..
	3.30	4.56	3.24	4.18	20.27	0.99	18.50	0.81	305.35	16.77	..	..
	–	–	–	–	–	–	–	–	270.78	3.48	..	..
	3.30	4.56	3.24	4.18	20.27	0.99	18.50	0.81	210.14	41.25	..	..
	21.46	29.65	22.65	29.24	220.26	10.73	217.20	9.50	777.96	10.00	..	..
	24.76	**34.22**	**25.89**	**33.42**	**240.53**	**11.72**	**235.70**	**10.31**	**988.11**	**51.24**	**..**	**..**
	1.98	2.74	2.59	3.34	84.13	4.10	88.70	3.88	229.66	2.95	..	..
	–	–	–	–	39.94	1.95	36.40	1.59	87.52	1.12	..	..
	–	–	–	–	3.85	0.19	4.40	0.19	44.90	0.58	..	..
	1.98	**2.74**	**2.59**	**3.34**	**128.02**	**6.24**	**129.50**	**5.67**	**362.19**	**4.65**	**..**	**..**
	0.50	0.68	0.49	0.63	–	–	–	–	31.54	0.41	..	..
	30.70	42.43	31.55	40.73	828.62	40.38	976.20	42.71	047.42	13.46	..	..
	31.20	**43.11**	**32.04**	**41.35**	**828.62**	**40.38**	**976.20**	**42.71**	**078.97**	**13.86**	**..**	**..**
	72.37	**100.00**	**77.48**	**100.00**	**052.15**	**100.00**	**2 285.50**	**100.00**	**782.69**	**100.00**	**..**	**..**

Switzerland, Total Reported has not been calculated for 1999.

C

ANNEX

INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The Member countries* of the International Energy Agency (IEA) seek to create the conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants.

In order to secure their objectives they therefore aim to create a policy framework consistent with the following goals:

1 **Diversity, efficiency and flexibility within the energy sector** are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2 Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3 **The environmentally sustainable provision and use of energy** is central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should where practicable have regard to the Polluter Pays Principle.

4 **More environmentally acceptable energy sources** need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of

* Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

IEA Members wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5 **Improved energy efficiency** can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6 **Continued research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7 **Undistorted energy prices** enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8 **Free and open trade** and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9 **Co-operation among all energy market participants** helps to improve information and understanding, and encourage the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at their 4 June 1993 meeting in Paris.)

ANNEX

MEASUREMENT OF FINANCIAL SUPPORT FOR COAL PRODUCTION USING A PRODUCER SUBSIDY EQUIVALENT CALCULATION

Introduction

This annex describes the Producer Subsidy Equivalent (PSE) calculation and provides an interpretation of its application to forms of financial support for coal production. The purpose of the PSE is to provide a single measure of the financial support provided by a variety of components so that the extent of support between countries and the movement over time can be considered. The aim has been to include in the PSE all items of support provided to the current domestic production of coal that the industry itself would normally be expected to cover in a competitive situation. These include not only direct state payments but also the value of protection provided by import constraints and the practical effects of special sales agreements.

PSEs and their Interpretation

A PSE defines the monetary payment to domestic producers equivalent to the total value of existing support provided at current levels of production, consumption and trade, and hence world prices. Put in another way, it is the payment that would just keep all domestic production competitive with imports at existing levels of coal output, current producer incomes and import prices. It thus evaluates the support system that maintains domestic production and imports at their current levels. Clearly, if all support systems for high-cost coal production in all countries were withdrawn at once, world coal import requirements would likely rise, and with them coal import prices in the short term. In the resulting equilibrium situation, with no systems of support remaining, the PSE would be zero. However, the PSE in a given year does not presuppose some different level of imports, it only evaluates the system of support that is maintaining the existing situation.

It is important to keep in mind this aspect of the PSE as a static measure when interpreting the results of the calculations. In the 1987 review of *Coal Prospects and Policies in IEA Countries,* for example, it is argued that the coal prices that prevailed in the international markets of 1987 are not sustainable in the longer run in the sense that at these prices coal exporters would not be willing to invest in significant additional production facilities because they would be unable to earn an adequate rate of return on the capital involved. Similarly, appraisal analyses for investment, disinvestment or policy change decisions would need to take account of expected future prices. In the medium to longer term it would be prudent to assume that future prices will be close to sustainable levels when additional production capacity will be needed to meet growing coal demand. However, the PSE methodology does not anticipate situations in the future; for each particular year it uses data from that year only; it does not use data relating to some other year, a trend year or an optimal situation.

The PSE method is purely descriptive. It merely provides a measure that can be used as an aid evaluating the support systems for domestic coal production that maintain the current situation in terms of the levels of domestic production, trade and world prices. The PSE does not provide a useful basis for making decisions on mine closures or coal purchase contracts. Nor is it a measure of savings that could be realised immediately if protected production were closed down.

The PSE does provide, however, a useful but limited indication of the scale of support to indigenous coal production and the differences between countries in this respect. No alternative measure is available for these purposes. The PSE is not a prescriptive tool; it cannot be used to explain why a support system exists nor can it suggest how, how much or how fast a support system should be changed. It takes no account of the social, regional and unemployment problems experienced to date, or likely to arise in the future, from actions to reduce protection or of the costs of dealing with those problems. It does not reflect changes in policy taken now to reduce support in the future and it does not distinguish between temporary support to pave the way to a viable coal industry and long-term support with no such prospect. It takes no account of emerging trends of domestic coal production and the increasing importance of imported coal. It takes no account of any price distortions arising from supportive financial measures, royalties or taxes in coal exporting countries. Above all, the PSE measure, as calculated in the tables, is not precise.

The General Method

In the tables given in the individual country reviews, the total PSE for each country examined is obtained by adding together the relevant net budgetary payments to producers and the calculated value of the indirect measures, as described below. The aim is to include in the PSE the total value of those forms of protection provided to the domestic coal industry that the industry itself would normally be expected to cover in a competitive situation.

Support for production normally takes two forms: direct (or budgetary) assistance and price support. Many direct monetary payments to producers, such as government deficit payments, clearly help to maintain current domestic production and are therefore included in the calculation of the PSE. Other direct payments are designed to speed contraction of the industry, or are otherwise unrelated to current production, and are therefore excluded from the PSE.

Price support is typically provided in one of two main ways:

- by government-imposed limitations on coal imports;
- as the result of some long-term agreements between coal producers and large coal consumers (usually electric utilities), arranged directly and on a bilateral basis or involving government in tripartite agreements.

The details of these latter arrangements are frequently complex and specified in statutes or private contracts. Many of the arrangements are of long standing, though they may have been modified over the years. Published information is limited and sometimes unavailable when confidential, commercial contracts are involved.

There is scope for argument about whether specific long-term arrangements between coal producers and major consumers, particularly electricity generating utilities, constitute support when they are not underpinned by government measures such as restrictions on coal imports. The issue turns on the extent to which:

- the utility in question entered into these arrangements because it considered that to fulfil its own obligations to maintain electricity supplies, it needed an assured long-term local source of coal supply, or
- it entered into the arrangement for reasons of national policy.

Whatever the answer to this question in a specific case, the practical effect of the arrangement on coal imports and prices in either case is the same as if there were protection for indigenous coal production. For the purposes of this study, all such arrangements have been included in the calculations of PSEs for the countries concerned.

Selection of an appropriate reference price, against which the domestic price is to be compared, is clearly critical to an accurate measurement of the level of support provided through high prices. Ideally, the two sets of prices should compare like with like – that is, they should relate to commodities of similar quality and conditions of exchange (e.g. contract lengths). With coal, as with many commodities, however, it is often the case that none of the available reference price series perfectly fits this ideal, and so the result must inevitably be approximate.

Because price information is not usually available for individual transactions, both the domestic and the reference prices have been calculated for an average or typical consumer. Where possible, however, the difference between the actual price received by domestic consumers and the reference price has been calculated for comparable coal qualities and for similar lengths of contract. Differences in thermal quality between domestic and imported steam coals have been adjusted by expressing prices (and quantities) in thermal-equivalent terms. When comparing coking coal, other properties, such as coke strength, have been taken into account. Inevitably, such adjustments mean that individual prices are specified separately for each country. This causes no great conceptual problems as long as the general principles are applied consistently in each case.

For purposes of comparison, the total PSE for each country has been divided in each year by the affected production, to yield an average PSE per tonne produced. Such a calculation undoubtedly conceals any dispersion there may be in support for production within individual countries. Thus some mines may require more support than the average and some less, perhaps none at all.

E

ANNEX

GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention and abbreviated subsequently, this glossary provides a quick and central reference for many of the abbreviations used.

bcm	billion cubic metres.
b/d	barrels per day.
cal	calorie.
CERT	Committee on Energy Research and Technology of the IEA.
CFCs	chlorofluorocarbons.
CHP	combined production of heat and power; sometimes, when referring to industrial CHP, the term "co-generation" is used.
CO_2	carbon dioxide.
ECU	European Currency Unit.
EU	The European Union, whose members are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.
EFTA	Europe Free Trade Association: Iceland, Norway, Switzerland and Liechtenstein.
FCCC	Framework Convention on Climate Change.
FERC	Federal Electricity Regulatory Commission.
FSU	Former Soviet Union.
GDP	gross domestic product.
GHG	greenhouse gas.
GJ	gigajoule, or 1 joule $\times 10^9$.
GW	gigawatt, or 1 watt $\times 10^9$.
IEA	International Energy Agency whose Members are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

IPP	independent power producers.
J	joule; a joule is the work done when the point of application of a force of one newton is displaced through a distance of one metre in the direction of the force (a newton is defined as the force needed to accelerate a kilogram by one metre per second). In electrical units, it is the energy dissipated by one watt in a second.
LDC	local distribution companies.
LNG	liquefied natural gas.
LPG	liquefied petroleum gas; refers to propane, butane and their isomers, which are gases at atmospheric pressure and normal temperature.
LWR	light water reactor.
mcm	million cubic metres.
Mt	million tonnes.
Mtoe	million tonnes of oil equivalent; see toe.
MW	megawatt of electricity, or 1 Watt $\times 10^6$.
MWh	megawatt-hour = one megawatt $\times$ one hour, or one watt $\times$ one hour $\times 10^6$.
NEA	the Nuclear Energy Agency of the OECD.
OECD	Organisation for Economic Co-operation and Development.
OPEC	Organisation of Petroleum Exporting Countries.
ppm	parts per million.
PPP	purchasing power parity: the rate of currency conversion that equalises the purchasing power of different currencies, i.e. estimates the differences in price levels between different countries.
PSA	production sharing agreement.
PSE	producer subsidy equivalent.
R&D	research and development, especially in energy technology; may include the demonstration and dissemination phases as well.
SB	Single Buyer.
SLT	Standing Group on Long-Term Co-operation of the IEA.
TFC	total final consumption of energy; the difference between TPES and TFC consists of net energy losses in the production of electricity and synthetic gas, refinery use and other energy sector uses and losses.

toe	tonne of oil equivalent, defined as 10^7 kcal.
TPA	third party access.
TPES	total primary energy supply.
TW	terawatt, or 1 watt $\times 10^{12}$.
TWh	terawatt $\times$ one hour, or one watt $\times$ one hour $\times 10^{12}$.
WTO	World Trade Organisation.
Y2K	the year 2000.

ANNEX

FOOTNOTES TO ENERGY BALANCES AND KEY STATISTICAL DATA

[1] Includes lignite and peat, except for Finland, Ireland and Sweden. In these three cases, peat is shown separately.

[2] Comprises solid biomass and animal products, gas/liquids from biomass, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.

[3] Other includes tide, wave and ambient heat used in heat pumps.

[4] Total net imports include combustible renewables and waste.

[5] Total supply of electricity represents net trade. A negative number indicates that exports are greater than imports.

[6] Includes non-energy use.

[7] Includes less than 1% non-oil fuels.

[8] Includes residential, commercial, public service and agricultural sectors.

[9] Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.

[10] Losses arising in the production of electricity and heat at public utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 33% for nuclear, 10% for geothermal and 100% for hydro.

[11] Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.

[12] Toe per thousand US dollars at 1990 prices and exchange rates.

[13] Toe per person.

[14] "Energy-related CO_2 emissions" specifically means CO_2 from the combustion of the fossil fuel components of TPES (i.e. coal and coal products, peat, crude oil and derived products and natural gas), while CO_2 emissions from the remaining components of TPES (i.e. electricity from hydro, other renewables and nuclear) are zero. Emissions from the combustion of biomass-derived fuels are not included, in accordance with the IPCC greenhouse gas inventory methodology. TPES, by definition, excludes international marine bunkers. INC-IX decided in February 1994 that emissions from international marine and aviation bunkers should not be included in national totals but should be reported separately, as far as possible. CO_2 emissions from bunkers are those quantities of fuels delivered for international *marine* bunkers and the emissions arising from their use. Data for deliveries of fuel to international *aviation* bunkers are not generally available to the IEA and as a result, these emissions have not been deducted from the national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 1998 and applying this factor to forecast energy supply. Future coal emissions are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

ADDENDUM

THE CZECH REPUBLIC

As this volume went to press, the Czech Republic was on the verge of formally joining the International Energy Agency as its 25th Member state. We, therefore, decided to include as a special Addendum the full range of Czech energy statistics for 2000.

CZECH REPUBLIC

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	1997	1998	2005	2010	2015
TOTAL PRODUCTION		**38.51**	**38.52**	**32.81**	**30.79**	**27.30**	**25.60**	**23.30**
Coal[1]		38.01	34.71	28.23	26.04	19.00	17.00	14.50
Oil		0.04	0.21	0.44	0.43	0.20	0.20	0.20
Gas		0.36	0.20	0.16	0.17	0.20	0.20	0.20
Comb. Renewables & Wastes[2]		–	–	0.54	0.55	1.00	1.30	1.50
Nuclear		–	3.28	3.26	3.43	6.70	6.70	6.70
Hydro		0.09	0.12	0.15	0.12	0.20	0.20	0.20
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	–	0.04	0.04	–	–	–
TOTAL NET IMPORTS[4]		**6.99**	**7.63**	**10.47**	**10.55**	**12.60**	**15.50**	**19.30**
Coal1	Exports	2.59	7.29	6.59	6.23	5.60	4.00	2.00
	Imports	0.18	1.59	1.58	1.08	0.80	1.20	1.20
	Net Imports	–2.41	–5.70	–5.01	–5.15	–4.80	–2.80	–0.80
Oil	Exports	0.04	6.56	1.21	1.40	0.10	0.40	0.40
	Imports	8.91	15.16	9.18	9.70	7.40	8.00	8.20
	Bunkers	–	–	–	–	–	–	–
	Net Imports	8.87	8.60	7.97	8.30	7.30	7.60	7.80
Gas	Exports	0.01	–	0.00	0.00	–	–	–
	Imports	0.73	4.78	7.61	7.61	10.70	11.00	12.50
	Net Imports	0.72	4.78	7.61	7.61	10.70	11.00	12.50
Electricity	Exports	0.44	0.76	0.88	0.93	0.80	0.70	0.60
	Imports	0.25	0.70	0.78	0.72	0.20	0.40	0.40
	Net Imports	–0.19	–0.06	–0.10	–0.21	–0.60	–0.30	–0.20
TOTAL STOCK CHANGES		**–0.08**	**1.25**	**–0.78**	**–0.31**	**–0.70**	**–**	**–**
TOTAL SUPPLY (TPES)		**45.42**	**47.39**	**42.50**	**41.03**	**39.20**	**41.10**	**42.60**
Coal[1]		35.59	29.83	23.04	21.10	14.00	14.30	13.80
Oil		8.91	8.96	7.92	8.32	7.10	7.60	7.80
Gas		1.01	5.26	7.67	7.68	10.80	11.30	12.80
Comb. Renewables & Wastes[2]		–	–	0.54	0.55	1.00	1.30	1.50
Nuclear		–	3.28	3.26	3.43	6.70	6.70	6.70
Hydro		0.09	0.12	0.15	0.12	0.20	0.20	0.20
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	–	0.04	0.04	–	–	–
Electricity Trade[5]		–0.19	–0.06	–0.10	–0.21	–0.60	–0.30	–0.20
Shares (%)								
Coal		*78.4*	*63.0*	*54.2*	*51.4*	*35.7*	*34.8*	*32.4*
Oil		*19.6*	*18.9*	*18.6*	*20.3*	*18.1*	*18.5*	*18.3*
Gas		*2.2*	*11.1*	*18.0*	*18.7*	*27.6*	*27.5*	*30.0*
Comb. Renewables & Wastes		–	–	*1.3*	*1.3*	*2.6*	*3.2*	*3.5*
Nuclear		–	*6.9*	*7.7*	*8.4*	*17.1*	*16.3*	*15.7*
Hydro		*0.2*	*0.3*	*0.3*	*0.3*	*0.5*	*0.5*	*0.5*
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other		–	–	*0.1*	*0.1*	–	–	–
Electricity Trade		*–0.4*	*–0.1*	*–0.2*	*–0.5*	*–1.5*	*–0.7*	*–0.5*

0 is negligible, – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1997	1998	2005	2010	2015
TFC	**33.12**	**35.29**	**25.46**	**25.04**	**24.10**	**25.50**	**26.30**
Coal[1]	20.71	17.42	4.06	3.58	2.50	2.30	2.20
Oil	8.06	8.09	7.25	7.75	6.30	6.80	6.80
Gas	1.81	4.19	6.10	6.21	6.60	6.60	7.00
Comb. Renewables & Wastes[2]	–	–	0.31	0.31	0.40	0.40	0.50
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	2.54	4.14	4.27	4.20	4.10	4.70	5.00
Heat	–	1.45	3.46	2.99	4.20	4.70	4.80
Shares (%)							
Coal	*62.5*	*49.4*	*16.0*	*14.3*	*10.4*	*9.0*	*8.4*
Oil	*24.3*	*22.9*	*28.5*	*31.0*	*26.1*	*26.7*	*25.9*
Gas	*5.5*	*11.9*	*24.0*	*24.8*	*27.4*	*25.9*	*26.6*
Comb. Renewables & Wastes	–	–	*1.2*	*1.2*	*1.7*	*1.6*	*1.9*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*7.7*	*11.7*	*16.8*	*16.8*	*17.0*	*18.4*	*19.0*
Heat	–	*4.1*	*13.6*	*11.9*	*17.4*	*18.4*	*18.3*
TOTAL INDUSTRY[6]	**19.49**	**18.65**	**12.97**	**12.44**	**10.60**	**11.00**	**11.10**
Coal[1]	12.12	10.08	3.04	2.88	1.60	1.50	1.40
Oil	5.30	4.23	3.18	3.54	2.20	2.30	2.20
Gas	0.46	2.02	3.04	2.85	3.00	2.70	2.90
Comb. Renewables & Wastes[2]	–	–	–	–	0.20	0.20	0.20
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	1.61	2.32	1.60	1.62	1.50	1.80	1.90
Heat	–	–	2.11	1.55	2.10	2.50	2.50
Shares (%)							
Coal	*62.2*	*54.1*	*23.4*	*23.1*	*15.1*	*13.6*	*12.6*
Oil	*27.2*	*22.7*	*24.5*	*28.5*	*20.8*	*20.9*	*19.8*
Gas	*2.4*	*10.8*	*23.5*	*22.9*	*28.3*	*24.5*	*26.1*
Comb. Renewables & Wastes	–	–	–	–	*1.9*	*1.8*	*1.8*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*8.3*	*12.4*	*12.3*	*13.0*	*14.2*	*16.4*	*17.1*
Heat	–	–	*16.3*	*12.5*	*19.8*	*22.7*	*22.5*
TRANSPORT[7]	**2.46**	**2.86**	**3.82**	**3.93**	**3.90**	**4.50**	**4.70**
TOTAL OTHER SECTORS[8]	**11.17**	**13.78**	**8.67**	**8.67**	**9.60**	**10.00**	**10.50**
Coal[1]	8.46	7.34	1.03	0.70	0.90	0.80	0.80
Oil	0.60	1.27	0.48	0.51	0.40	0.40	0.40
Gas	1.35	2.17	3.03	3.33	3.60	3.70	3.80
Comb. Renewables & Wastes[2]	–	–	0.31	0.31	0.20	0.20	0.30
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.76	1.56	2.48	2.39	2.40	2.70	2.90
Heat	–	1.45	1.35	1.44	2.10	2.20	2.30
Shares (%)							
Coal	*75.7*	*53.2*	*11.8*	*8.1*	*9.4*	*8.0*	*7.6*
Oil	*5.4*	*9.2*	*5.5*	*5.9*	*4.2*	*4.0*	*3.8*
Gas	*12.1*	*15.7*	*34.9*	*38.4*	*37.5*	*37.0*	*36.2*
Comb. Renewables & Wastes	–	–	*3.6*	*3.6*	*2.1*	*2.0*	*2.9*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*6.8*	*11.3*	*28.6*	*27.5*	*25.0*	*27.0*	*27.6*
Heat	–	*10.5*	*15.5*	*16.6*	*21.9*	*22.0*	*21.9*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1997	1998	2005	2010	2015
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**9.70**	**16.70**	**20.41**	**19.66**	**22.20**	**23.60**	**24.40**
OUTPUT (Mtoe)	**3.54**	**5.38**	**5.52**	**5.56**	**5.92**	**6.22**	**6.48**
(TWh gross)	41.17	62.56	64.22	64.62	68.80	72.30	75.40
Output Shares (%)							
Coal	*85.1*	*71.8*	*72.7*	*71.6*	*50.6*	*51.3*	*47.7*
Oil	*11.3*	*4.8*	*1.0*	*1.0*	*1.0*	*1.1*	*1.3*
Gas	*0.9*	*1.0*	*2.7*	*3.2*	*7.7*	*8.6*	*13.0*
Comb. Renewables & Wastes	–	–	*0.8*	*0.9*	*0.9*	*1.1*	*1.6*
Nuclear	–	*20.1*	*19.5*	*20.4*	*37.4*	*35.5*	*34.1*
Hydro	*2.6*	*2.3*	*2.6*	*2.2*	*2.5*	*2.4*	*2.3*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.7*	*0.8*	–	–	–
TOTAL LOSSES	**13.46**	**13.44**	**15.08**	**14.47**	**15.10**	**15.60**	**16.30**
of which:							
Electricity and Heat Generation[10]	6.16	9.51	10.58	10.33	11.70	12.30	12.80
Other Transformation	5.74	1.46	1.41	1.10	1.00	0.90	1.00
Own Use and Losses[11]	1.57	2.48	3.09	3.04	2.40	2.40	2.50
Statistical Differences	**–1.16**	**–1.34**	**1.97**	**1.53**	**–**	**–**	**–**

INDICATORS

	1973	1990	1997	1998	2005	2010	2015
GDP (billion 1990 US$)	20.33	27.40	27.17	26.44	30.58	34.43	39.15
Population (millions)	9.92	10.36	10.30	10.30	10.30	10.30	10.20
TPES/GDP[12]	2.23	1.73	1.56	1.55	1.28	1.19	1.09
Energy Production/TPES	0.85	0.81	0.77	0.75	0.70	0.62	0.55
Per Capita TPES[13]	4.58	4.57	4.13	3.99	3.81	3.99	4.18
Oil Supply/GDP[12]	0.44	0.33	0.29	0.31	0.23	0.22	0.20
TFC/GDP[12]	1.63	1.29	0.94	0.95	0.79	0.74	0.67
Per Capita TFC[13]	3.34	3.41	2.47	2.43	2.34	2.48	2.58
Energy-related CO_2 Emissions (Mt CO_2)[14]	166.8	151.0	128.3	121.1	97.7	101.2	103.3
CO_2 Emissions from Bunkers (Mt CO_2)	–	–	–	–	–	–	–

GROWTH RATES (% per year)

	73–79	79–90	90–97	97–98	98–05	05–10	10–15
TPES	1.2	–0.2	–1.5	–3.5	–0.7	1.0	0.7
Coal	–0.3	–1.4	–3.6	–8.4	–5.7	0,4	–0,7
Oil	4.2	–2.2	–1.7	5.0	–2.2	1.4	0.5
Gas	14.3	8.0	5.5	0.2	5.0	0.9	2.5
Comb. Renewables & Wastes	–	–	–	2.4	8.8	5.4	2.9
Nuclear	–	–	–0.1	5.5	10.0	–	–
Hydro	13.3	–4.1	2.4	–17.8	7.6	–	–
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	10.5	–	–	–
TFC	2.8	–0.9	–4.6	–1.6	–0.5	1.1	0.6
Electricity Consumption	3.4	2.6	0.4	–1.5	–0.4	2.8	1.2
Energy Production	2.0	–1.0	–2.3	–6.2	–1.7	–1.3	–1.9
Net Oil Imports	3.9	–2.4	–1.1	4.2	–1.8	0.8	0.5
GDP	2.5	1.4	–0.1	–2.7	2.1	2.4	2.6
Growth in the TPES/GDP Ratio	–1.3	–1.6	–1.4	–0.8	–2.7	–1.4	–1.8
Growth in the TFC/GDP Ratio	0.3	–2.3	–4.4	1.1	–2.6	–1.2	–1.9

Please note: Rounding may cause totals to differ from the sum of the elements.

Order Form

OECD CENTRES

Please send your order by mail, fax, or by e-mail to your nearest OECD Centre

OECD BONN OFFICE

c/o DVG mbh (OECD)
Birkenmaarstrasse 8
D-53340 Meckenheim, Germany
Tel: (+49-2225) 926 166
Fax: (+49-2225) 926 169
E-mail: oecd@dvg.dsb.net
Internet: www.oecd.org/bonn

OECD MEXICO CENTRE

Edificio INFOTEC
Av. Presidente Mazarik 526
Colonia: Polanco
C.P. 11560 - Mexico D.F.
Tel: (+52-5) 280 12 09
Fax: (+52-5) 280 04 80
E-mail: mexico.contact@oecd.org
Internet: www.rtn.net.mx/ocde

OECD TOKYO CENTRE

Landic Akasaka Building
2-3-4 Akasaka, Minato-ku
Tokyo 107-0052, Japan
Tel: (+81-3) 3586 2016
Fax: (+81-3) 3584 7929
E-mail: center@oecdtokyo.org
Internet: www.oecdtokyo.org

OECD WASHINGTON CENTER

2001 L Street NW, Suite 650
Washington, D.C., 20036-4922, US
Tel: (+1-202) 785-6323
Toll-free number for orders:
(+1-800) 456-6323
Fax: (+1-202) 785-0350
E-mail: washington.contact@oecd.org
Internet: www.oecdwash.org

I would like to order the following publications

PUBLICATIONS	ISBN	QTY	PRICE*	TOTAL
☐ Energy Policies of IEA Countries – 2000 Review (Compendium)	92-64-18565-8		US$120	
☐ Energy Policies of IEA Countries – France – 2000 Review	92-64-18556-9		US$75	
☐ Energy Policies of IEA Countries – The Netherlands – 2000 Review	92-64-18555-0		US$75	
☐ Energy Policies of IEA Countries – Luxembourg – 2000 Review	92-64-18522-4		US$75	
☐ Energy Policies of IEA Countries – Sweden – 2000 Review	92-64-18523-2		US$75	
☐ Energy Policies of IEA Countries – Canada – 2000 Review	92-64-17682-9		US$75	
☐ Energy Policies of IEA Countries – Portugal – 2000 Review	92-64-17680-2		US$75	
			TOTAL	

*Postage and packing fees will be added to each order.

DELIVERY DETAILS

Name Organisation
Address

Country Postcode
Telephone Fax

PAYMENT DETAILS

☐ I enclose a cheque payable to IEA Publications for the sum of US$ ________ or FF ________

☐ Please debit my credit card (tick choice). ☐ Access/Mastercard ☐ Diners ☐ VISA ☐ AMEX

Card no:

Expiry date:

Signature:

IEA PUBLICATIONS, 9, rue de la Fédération, 75739 PARIS CEDEX 15
PRINTED IN FRANCE BY STEDI
(61 00 32 1P) ISBN 92-64-18565-8 - 2000